KIRKUK UNIVERSITY JOURNAL
FOR AGRICULTURAL SCIENCES

Estimation of genetic parameters for egg production traits in Japanese quail that selected for immune responses and fed different level of dietary L-arginine

Ahmed Sami Shaker [1] Ayhan Kamal Mohammed[2] Waleed Mohammed Razuki [3]

kosrat_ahmed@yahoo.com bayraktara451@gmail.com drwaleedrazuki@yahoo.com

[1] Animal production department, directorate of agricultural research, Slemani, KGR, Iraq.

[2] Animal production department, college of agriculture, Kirkuk University, Kirkuk, Iraq.

[3] Poultry research station، Office of agricultural research, Ministry of agriculture, Iraq

• Date of research received 12/02/2022 and accepted 15/03/2023

• Part of PhD. dissertation for first author.

Abstract

This study was conducted in the fields of the Department of Animal Production - College of Agriculture at Kirkuk University for the period from 6/14/2021 to 7/30/2022. 750 quail chicks were supplied from the Poultry Research Station of the Agricultural Research Department in Abu Ghraib. The chicks were fed the starter ration until the age of 30 days, and then they were fed the production ration. At the age of 4 weeks, the chicks were vaccinated with the attenuated Newcastle vaccine, and the chicks were divided into six experimental treatments: the first treatment represented the negative control group that was not vaccinated and did not have the amino acid arginine added to it, the second treatment represented the positive control group whose chicks were vaccinated with the Newcastle vaccine with no arginine added to their diet As for the third and fourth treatments, they were vaccinated with the Newcastle vaccine with the addition of 5% arginine higher than the bird's needs. The fifth and sixth treatments represented groups of birds vaccinated with the Newcastle vaccine, while feeding the birds with diets to which the amino acid arginine was added, 10% higher than the bird's needs. A week after the initial immunization, the bird was vaccinated again with Newcastle vaccine, and the immune level was examined by the agglutination test to find out the level of the birds' immune response, dividing them into two levels of high immune response and low immune response. This process was repeated for the next three generations. The characteristic of egg production at the age of 90 and 120 days, and the egg mass was recorded. The data were analyzed according to the general linear model method using the ready-made statistical program SAS. The genetic equivalent and the genetic and phenotypic correlations were estimated. The characteristics of egg production decreased until the age of 90 and 120 days, as well as the mass of eggs at the age of

120 days, compared to the base population (21.61 vs. 34.84), (22.01 vs. 26.53), (323.47 vs. 545.97), respectively. The egg mass was significantly affected by the level of immunity and the percentage of added arginine, where the highest value of the egg mass was for birds selected for the high immune level and to which arginine was added by 10% higher than the needs of the bird. Estimates of genotyped egg production at 90 and 120 days of age and egg mass at 120 days of age were (0.64, 0.65 and 0.21), respectively. The results showed weak genetic correlations (0.0263) between egg production at the age of 90 days and egg production at the age of 120 days, but the phenotypic correlations were high (0.6248) between egg production at the age of 90 days and egg production at the age of 120 days. The current study indicates that the selection of birds according to the immune response against Newcastle disease led to decrease in egg production and egg mass. Addition the Arginine amino acid did not increase production at the age of 90 and 120 days. While the addition of arginine 10% led to an increase in the egg mass.

Key words: genetic parameter, egg production, arginine, quail, and immune.

Citation: Ahmed S. Shaker; Ayhan K. Mohammed; Waleed M. Razuki. "Estimation of genetic parameters for egg production traits in Japanese quail that selected for immune responses and fed different level of dietary L-arginine". *Kirkuk University Journal For Agricultural Sciences*, 14, 1, 2023, 73-81. doi: 10.58928/ku23.14106

Correspondence Author: Ahmed Sami Shaker, kosrat_ahmed@yahoo.com

Introduction

The Japanese quail is considered one of the birds that can be a good model for studying immunological research, due to its small size, little use of feed, and the small size of the place it occupies [1]; [2]; [3]; [4]. It was used by [5] to study selection for several generations against Newcastle disease antigens, and to know the effect of selection on some productive traits such as average egg weight, egg production, hatching rate, and fertility rate.

[6] was used two genetic lines of Japanese quail to study the effects of immune selection against NDV resistance for nine generation on the egg production traits. His noticed there was no significant differences in egg production traits between the lines. [7] were used two genetic lines of chicken, one with high immune response and the other with low immune response in his study, His result showed that the egg production in the low immune response had a higher rate of egg production than the high immune response. Also, egg weight was higher in the low immune response compare with high immune response (49.94, and 48.27) g, respectively .

Arginine is an important source of protein synthesis substrates as well as a precursor for many molecules such as nitric oxide, Creatine, ornithine, glutamate, polyamines, and Proline [8]. Moreover the daily requirement of this acid is almost different between the types of breeds within the same species and between the sexes and the different age of the birds. On the other hand, an antagonist state occurs between it and the amino acid lysine when one of them is increased by a percentage greater than that stipulated in the breeding guides and recommendations proposed by the US National Research Council [9]. Several researchers used arginine; to enhance the immune response [10], increase the egg production [11], wound healing [12], and the stress [13].

The current study is carried out to establish lines of quails characterized by a high level of antibodies to Newcastle disease, and fed with diets high in the content of the amino acid arginine for three generations of Japanese quails, and to study its effect on egg production and to evaluate the genetic parameters.

Materials and methods

The current study was carried out at the poultry farm at animal production department, College of agriculture, Kirkuk University from 12/6/2021 until 14/7/2022. The study aimed to determine the effect of immune selection after three generations in the egg production and egg mass of the Japanese quail. Initially, 750-day old unsexed Japanese quail chicks were obtained from the directorate of agricultural Research-Baghdad. Chicks were raised on floor cages and fed starter feed (Table1) until 30 days old. After that, the birds were sexed and transferred to battery cages; each cage contains male and two females and fed with production feed (Table1).

Table 1: The percentage and chemical composition of fed materials used in the formation of starter diet and productivity of Japanese quail birds

Material	Starter (Kg)	Production (Kg)
Yellow corn	56.1	55.6
Soybean meal (48% crud protein)	37	27
Wheat	0	5
Oil	0.2	1.3
Premix	5	5
Limestone	1.4	5.6
Di-calcium phosphate	0	0.2
Salt	0.3	0.3
Total	100	100
Chemical analysis		
Protein (CP)	24.16	20.02
Metabolism Energy (kcal/kg)	2906.18	2900.43
Fibers(%)	2.82	2.57
Fat(%)	2.95	4.06
Lysine(%)	1.43	1.15
Methionine(%)	0.49	0.43
Calcium(%)	0.81	2.43
Phosphor (%)	0.36	0.38
Arginine (%)	1.62	1.29

After immunizing the birds by inactivated Newcastle disease virus, and tested by the hemagglutination test. The families were divided to six treatments (negative control; positive control; high immune response, with adding 5% arginine; low immune response, with adding 5% arginine; high immune response, with adding 10% arginine; low immune response, with adding 10% arginine). Each family was housed separately in a breeding cage (25. 25. 25 cm) with a sloping floor for collecting the eggs and numbered according to their sire families, each treatment consists of 18 families. Egg production was recorded daily and individually from sexual maturity to 120 days. These eggs were incubated to get the first selected generation (G1), and then the selection was breed to obtain the consecutive second (G2), and third (G3) selected generations.

Data analysis was conducted using the general linear model method within [14] to estimate the effect of factors influencing the studied traits, according to the model below to obtain the best linear estimate of the fixed traits.

$$Yijkl = \mu + Gi + IMj + GIMij + Sk + eijkl$$

Where:

Yijkl = individual observation
μ = overall mean
Gi = generation effect
IMj = immune level and arginine additive
GIMij = the interaction between generation and immune level
Sk = sire effect
eijkl = residual error

The CIA-Common Intercept Approach was adopted to reach the point of inflection (Convergence) in estimating the components of the variance in the fastest time and with the least number of cycles [15], and then a matrix of variance and covariance (VCV) was formed from the variances and co-variances for each From random effects (Sire and error) separately, then the positive definite test was conducted, as these matrices must have realistic values (Exist) and the associated eigenvalues matrix must be positive and determined for the purpose of obtaining Estimates of genetic parameters (heritability, genotypic correlation, phenotypic correlation) are within the permissible limits.

This test was conducted on the matrices of variances and variations of the father and the error for each group of traits studied separately by calculating the eigenvalues associated with the test matrix. It was found that some of traits were negative, so the Bending process had to be performed [16], and new matrices of variances and variations were obtained, from which the heritability of the studied traits and the genetic and phenotypic correlations between them were estimated.

Result and discussion

The mean and standard error of the egg production in 90, 120 days and the egg mass for the four-generation, immune level are shown in (Table 2). The egg production in 90, 120 days was significantly differing ($P \leq 0.0001$) among the generations (Table 3). Egg production 90 days was higher in base generation and low in generation three (34.84, and 21.61) respectively. The egg production in 120 days also was higher in base generation and lower in generation three (26.53, and 22.01) respectively. The egg mass was significantly differing among the generation also (Table 3), it was higher in the base generation and lower in the generation three (545.97, and 323.47) respectively .

The effect of immune levels and arginine concentration was non-significant in both egg production on 90, and 120 days (Table 2). The egg mass was significant differs among the levels ($P \leq 0.05$). It was higher in (3 H) and lower in (CP), which were (462.02, and 421.35) respectively. The interaction was non-significant among the generations and the Immune levels (Table 3).

The heritability estimates for egg production in 90 days, 120 days, and egg mass were (0.6453, 0.6523, 0.2065) respectively (Table 4). The higher genetic correlation was (0.0263) between the egg production in 90, and 120 days. The genetic correlation between the egg productions in 90, 120 days with egg mass were negative (- 0.0159, and - 0.0040) respectively. Moreover, the higher phenotypic correlation was between the egg productions in 90 days with the egg mass (0.6248), and the lowest was between egg productions in 90 days with egg production in 120 days (0.1388).

[5] in his study of immuno selection of Japanese quail against Newcastle disease for nine generations, found that egg production did not differ significant difference between the generations. [6] also found that egg production at the age of 45 days after maturity did not differ significantly between the four generations selected for two genetic lines, one of which was high immunity and the other low for Newcastle disease antigens.

[8] found that adding different levels of arginine and lysine by 0.1, and 0.2 % in the diet of Japanese quail did not affect significantly on the egg production and the sexual maturity .

[17] showed that the genetic and phenotypic correlation between the characteristic of the number of eggs produced

and the characteristic of egg weight was negatively correlated (- 0.22, - 0.18) in three chicken breeds (Penedesenca Negre, Prat Lleonada, Empordanesa Roja), and estimates of the heritability for the egg production were 0.20, 0.31, and 0.33 respectively. While in a study by the researcher [18] in which the Japanese quail was used, the phenotypic correlations for the characteristic of egg production between the productive periods were all positive and ranged between the three productive lines between (0.173 - 0.614, 0.110 - 0.465, 0.015 - 0.371), respectively.

Table 2: The effect of generation, immune level, and the amino acid arginine on egg production at 90 and 120 days of age and the egg mass at 120 days (Means ± S.E.)

Factors	EP90D		EP120D		EM	
	No.	Means ± S.E.	No.	Means ± S.E.	No.	Means ± S.E.
Overall mean	625	28.31±0.14	620	24.37±0.11	589	443.51±2.25
Generation (G):						
0	195	34.84±0.38 **a**	189	26.53±0.25 **a**	174	545.97±5.53 **a**
1	156	27.67±0.42 **b**	157	23.63±0.27 **c**	151	450.35±5.94 **b**
2	148	26.12±0.43 **c**	148	24.43±0.28 **b**	143	413.23±6.12 **c**
3	126	21.61±0.47 **d**	126	22.01±0.31 **d**	121	323.47±6.66 **d**
Immunity level (I):						
1 Control (-) (CN)	102	28.92±0.53 **n.s**	100	24.10±0.35 **n.s**	94	440.58±7.59 **abc**
1Control (+) (CP)	107	28.43±0.52 **n.s**	106	24.17±0.34 **n.s**	96	421.35±7.53 **c**
2 High Immune (2H)	115	27.81±0.49 **n.s**	113	24.24±0.32 **n.s**	108	436.61±7.04 **bc**
2 Low Immune (2L)	95	27.44±0.55 **n.s**	96	24.58±0.35 **n.s**	91	445.09±7.70 **ab**
3 High Immune (3H)	97	28.90±0.54 **n.s**	97	24.33±0.35 **n.s**	97	462.02±7.54 **a**
3 Low Immune (3L)	109	28.41±0.51 **n.s**	108	24.85±0.33 **n.s**	103	455.27±7.24 **ab**

EP90D=egg production 90 days; EP120D=egg production 120 days; EM=egg mass. a-d = indicate significant differences between means in same column.

Table 3: Mean squares and test of significance for factors affecting egg production at, 90 days and 120 days, and egg mass in quail.

Factors	EP90D		EP120D		EM	
	d.f.	Means squares	d.f.	Means squares	d.f.	Means squares
Generation (G)	3	4849.79***	3	553.02***	3	1227833.18***
Immunity level (I)	5	21.75 n.s.	5	10.05 n.s.	5	18701.32**
Interaction (G*I)	15	18.82 n.s.	15	8.34 n.s.	15	6109.74 n.s.
Residual	601	28.29	596	12.04	565	5324.73

*** p<0.001, ** p<0.01, * p<0.05, N.S.=non-significant. EP90D=egg production 90 days; EP120D=egg production 120 days; EM=egg mass. D.f= degree of freedom

[19] also mentioned in his study that the genetic equivalent of egg production in two strains of Japanese quail selected for the highest body weight and for different productive periods was low in the strain (UFV1) and for five productive periods (42 to 77 days, 77 to 112 days, 122 to 147 days, 147 to 182 days, and 42 to 407 days) and reached 0.03, 0.06, 0.07, 0.08, and 0.16, respectively.

As for the other strain (UFV2), the estimates were 0.20, 0.23, 0.25, 0.25, 0.22, and the researcher explained this difference. Between the values of the heritability according to the difference in the method of selecting and the environmental conditions in which it was reared, given that the two flocks belong to two different regions. The difference of our results from the results of previous studies may be due to the level of arginine added to the diet, as the researcher [20] showed that the estimates of the heritability change according to the chicken breeds used, the breeding method, and the age of the bird.

Table 4: Genetic parameters for the egg production 90, 120 days and egg mass in quail

Traits	EP90D	EP120D	EM
EP90D	**0.6453**	0.0263	- 0.0159
EP120D	0.1388	**0.6523**	- 0.0040
EM	0.6248	0.4693	**0.2065**

The values on, above, and below the diagonal are estimates of heritability, genetic and phenotypic correlation among traits respectively. ** p<0.01. EP90D=egg production 90 days; EP120D=egg production 120 days; EM=egg mass.

Conclusion

Selection of birds according to the immune response against Newcastle disease led to decrease in egg production and egg mass. Addition the Arginine amino acid did not increase production at the age of 90 and 120 days. While the addition of arginine 10% led to an increase in the egg mass.

References

[1]Mizutani, M. (2003). The Japanese quail, Laboratory animal research station, Nippon Institute for Biological Science. Kobuchizawa, Yamanashi, Japan.

[2] Baha Al-Deen, Mohammed Sabah, Abdullah, Mariya Mustafa. (2019). Effect of adding different sources of energy in quail diets on some chemical characteristics and physical and sensory characteristics of quail meat. Journal of Kirkuk university for agricultural sciences, volume 2018, 182-187.

[3] Hassa, Sara Hatem Abdulla, Baha Al-Deen, Mohammed Sabah (2019). Study the effect of species and sex in some physiochemical and qualities and quantities sensory of quail carcass. Journal of Kirkuk university for agricultural sciences, volume 2018, 258-269

[4] Altamimi, Hasan Ghaleb, Wahib, Abdel Wahab Mohamed (2020). The effect of feed restriction and birds density on some production traits for female quail. Journal of Kirkuk university for agricultural sciences, volume 11 (1), 25-38

[5] Takahashi, S., Inooka, S., & Mizuma, Y. (1984). Selective breeding for high and low antibody responses to inactivated newcastle disease virus in Japanese quails. Poultry science, 63, 595-599.

[6] Mandour, M. A., Sharaf, M. M., & Helal, M. A. (2003). Selection for immune response in Japanese quail. Kafr El-Sheikh Vet. Med. J., 1(1), 935-952.

[7] Okabayashi, H., & Kosugi, Y. (1992). Egg production traits as correlated responses to the selection for immune responses in chicken. Jpn. Poult. Sci., 29, 296-300.

[8]Bulbul, T., Ulutas, E., & Evcimen, M. (2015). Effect of dietary supplementation of arginine and lysine on performance and egg quality characteristics of laying quails. Ankra Univ Vet Fak Derg, 62, 307-312

[9] National Research Council, (1994). Nutrient Requirements of Poultry. 9th. Rev. Ed. National Academy Press. Washington DC.

[10] Kwak, H., Astic, R. E., & Dietart, R. R. (1999). Influence of dietary arginine concentration on lymphoid organ in chickens. Poult. Sci., 78, 1536-1541.

[11]Manwar, S. J., Moudgal, R. P., Sastry, K. H., Mohan, J., Tyagi, J., & Raina, R. (2006). Role of nitric oxide in ovarian follicular development and egg production in Japanese quail (Coturnix coturnix japanico). Theriogenology, 65, 1392-1400.

[12] Evoy, D., Lieberman, M. D., Fahey, T. J., & Daly, J. M. (1998). Immunonutrition: The role of arginine. Nutrition, 14, 611-617.

[13] Ruiz-Feria, C. A., Kidd, M. T., & Wideman, R. F. (2001). Plasma levels of arginine, ornthione, and urea and grouth performance of broilers fed supplemental

L-arginine during cool temperature exposure. Poult. Sci., 80, 358-369.

[14] SAS. (2005). SAS/STAT' User's guide for personal computers. Release 8.2. SAS institute Inc., Cary, NC, USA.

[15] Schaeffer, L. R. (1979). Notes on linear model theory and henderson's mixed model techniques. University Guelph: Mimeo.

[16] Hayes, J. F., & Hill, W. G. (1981). Modification of estimates of parameters in the construction of genetic selection indices (Bending). Biometrics, 483-493.

[17] Francesch, A., Estany, J., Alfonso, L., & Iglesia, M. (1997). Genetic parameters for egg number, egg weight, and egg shell color in three catalan poultry breeds. Poultry science, 76, 1627-1631.

[18] Monika, M., Rokadae, J. J., & Narayan, R. (2021). Genetic evaluation of egg production and egg quality attributes in Japanee quails through partial periods. Indian journal of animal research, 1-8.

[19] Ribeiro, J. C., Silva, L. P., Soares, A. C., Caetano, G. C., Leite, C. D., Bonafe, C. M., & Torres, R. d. (2017). Genetic parameters for egg production in meat quails through partial periods. Ciencia Rural, Santa Maria, 47.(4)

[20] Nurgiartiningsih, V., Mielenz, N., Preisinger, R., Schmutz, M., & Schuler, L. (2002). Genetic parameters for egg production and egg weight of laying hens housed in single and group cagers. Arch. Tierz, 45(5), 501-508.

مجلة جامعة كركوك للعلوم الزراعية

تقدير المعالم الوراثية لصفة إنتاج البيض في السمان الياباني التي تم انتخابها للاستجابات المناعية والمغذاة بمستويات مختلفة من الارجينين

احمد سامي شاكر [1] ايهان كمال محمد [2] وليد محمد رزوقي [3]

kosrat_ahmed@yahoo.com bayraktara451@uokirk gmail.com drwaleedrazuki@yahoo.com

[1] قسم الانتاج الحيواني، مديرية البحوث الزراعية، السليمانية، العراق
[2] قسم الانتاج الحيواني، كلية الزراعة، جامعة كركوك، كركوك، العراق
[3] محطة بحوث الدواجن، مديرية الابحاث الزراعية، وزارة الزراعة، العراق

- تاريخ استلام البحث 12/02/2023 وتاريخ قبوله 15/03/2023
- البحث مستل من اطروحة الدكتوراه للباحث الاول .

المستخلص

أجريت هذه الدراسة في حقول قسم الإنتاج الحيواني – كلية الزراعة في جامعة كركوك للفترة من 2021/6/14 إلى 2022/7/30. تم الحصول على 750 فرخ سمان من محطة بحوث الدواجن التابعة للادارة البحوث الزراعية في أبو غريب. اذ تم تغذية الافراخ بالعليقة البادئة حتى عمر 30 يوما ، ثم تم تغذيتهم بالعليقة الانتاجية في عمر 4 أسابيع وتم تحصين الافراخ بلقاح نيوكاسل المضعف ، وقسمت الافراخ إلى ستة معاملات تجريبية: المعاملة الأول تمثل مجموعة السيطرة السالبة التي لم يتم تحصينها ولم يضاف إليها الحمض الأميني أرجينين اما المعاملة الثانية تمثل مجموعة السيطرة الموجبة التي تم تحصين افراخها بلقاح نيوكاسل بدون إضافة أرجينين إلى عليقتهم، أما بالنسبة للمعاملة الثالثة والرابعة فقد تم تطعيمهم بلقاح نيوكاسل بإضافة 5٪ أرجينين أعلى من احتياجات الطيور. تمثل المعاملتان الخامس والسادس الطيور المحصنة بلقاح نيوكاسل ، بينما تم تغذية الطيور بالعلائق التي أضيف إليها حمض الأرجينين الأميني بنسبة 10٪ أعلى من احتياجات الطيور. بعد أسبوع من التطعيم الأولي ، تم تطعيم الطائر مرة أخرى بلقاح نيوكاسل ، وتم فحص المستوى المناعي باختبار التراص لمعرفة مستوى الاستجابة المناعية للطيور ، وتقسيمها إلى مستويين من الاستجابة المناعية العالية والمنخفضة. تكررت هذه العملية للأجيال الثلاثة التالية. تم تسجيل صفة إنتاج البيض في عمر 90 و 120 يومًا ، وتم تسجيل كتلة البيض. تم تحليل البيانات وفق أسلوب النموذج الخطي العام باستخدام البرنامج الإحصائي الجاهز .SAS اذ تم تقدير المكافئ الوراثي والارتباطات الوراثية والمظهرية. ومن خلال التحليل الاحصائي وجد انخفاض في صفة إنتاج البيض عند عمر 90 و 120 يومًا ، وكذلك انخفضت كتلة البيض بعمر 120 يومًا ، مقارنة بالجيل الاساس (21.61 مقابل 34.84) ، (22.01 مقابل 26.53) ، (323.47) مقابل 545.97) على التوالي، و تأثرت كتلة البيض معنويا بمستوى المناعة ونسبة الأرجينين المضافة ، اذ كانت أعلى قيمة لكتلة البيض للطيور المنتخبة لمستوى مناعي عالي والتي أضيف إليها الأرجينين بنسبة 10٪ أعلى من احتياجات الارجينين. كان المكافئ الوراثي لصفة إنتاج البيض عند عمر 90 و 120 يومًا وكتلة البيض عند عمر 120 يومًا (0.64 و 0.65 و 0.21) على التوالي. أظهرت النتائج ارتباط الوراثي منخفض (0.0263) بين إنتاج البيض في عمر 90 يومًا وإنتاج البيض في عمر 120 يومًا ، لكن الارتباط المظهري كان مرتفعًا

(0.6248) بين إنتاج البيض في عمر 90 يومًا وإنتاج البيض في عمر 90 يومًا. بعمر 120 يوم. تشير الدراسة الحالية إلى أن انتخاب الطيور وفقًا للاستجابة المناعية ضد مرض نيوكاسل أدى إلى انخفاض إنتاج البيض وكتلة البيض. إضافة حمض الأرجينين الأميني لم يزيد الإنتاج في عمر 90 و 120 يومًا، بينما أدت إضافة الأرجينين 10٪ إلى زيادة كتلة البيض.

الكلمات المفتاحية : المعلمة الجينية ، إنتاج البيض ، الأرجينين ، السمان ، المناعة.