The interior quality of egg in four outbred F1 populations of Japanese quail

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Abstract. This study was conducted to evaluate the interior quality of egg in four outbred F1 population of Japanese quail. Two hundred Japanese quails were used in this study. They were grouped into four lines based on their mating systems, i.e. male brown quail 1 and female black quail 2 (BL1), male brown 2 and female black 1 (BL2), male black 1 and female brown 2 (LB1), and male black 2 and female quail 1 (LB2). Each line consisted of 50 quails. Eggs were collected at the age of 10 weeks. Interior egg characteristics were tested for three consecutive days. They were height, weight, and index of albumen; weight, height, and index of yolk, yolk color score, and Haugh unit (HU). The data was analyzed using one-way analysis of variance (ANOVA), and pairwise differences among lines were performed using Duncan's multiple range test (DMRT). The results showed that albumen weight and yolk height were significantly different among lines (P<0.05). Better albumen weight and yolk height were found in LB populations. Other traits were not different among outbreeding populations. It can be concluded that the best interior qualities of egg were produced by LB quail populations.

1. Introduction

The reputation of quail in small-holder farmers is steadily increased in Indonesia nowadays. Quail is a small poultry species which is easy to be maintained due to fast growing. There are 17 to 18 types of quail in the world, including three popular quail breeds such as Japanese quail, Bobwhite, King and Stable [1]. Quail maintenance is easy, low feed consumption (around 20 g/bird/day), fast growth, hatching at 17 days, and started laying at 41 days [2]. Excellence quail has a short life cycle, fast sexual maturity, easy handling and resistance to diseases [3].

Quails have high egg production every year. Quail productivity can reach 280 to 300 eggs per year with 10 g per egg [4]. High egg production must be supported by good egg quality. Good quality eggs can be obtained with superior a day old quail (DOQ). Good DOQ can be pursued by outbreeding. Outbreeding is an alternative to form offspring that are expected to have complementary effects which are inherited by their parents [5].

Egg quality must be maintained due to directly affect consumer preferences. Low egg quality triggers to decreasing of consumer interest. The quality of eggs can be judged by the quality of the...
exterior and interior. Egg quality can be observed by measuring the yolk index, albumen index, and the Haugh Unit (HU) value [6]. One of the parameters determining the characteristics of egg quality is by measurement of external and internal quality of egg [7]. Internal quality is observable egg quality parameters by breaking egg including albumen characteristics, yolk characteristics, Haugh Unit (HU) values and the presence or absence of egg abnormalities [8].

Difference in plumage color of quail shows significant results on albumen index. Dark brown quail albumen index is lower than light brown quail, i.e. 10.78% vs 11.8% [9]. Yolk index is also affected by plumage quail line. The HU values are also different among lines 86.43 for white, 86.45 for dark brown, 86.85 for gold, and 86.43 for wild type [10]. Based on the description above, this research was conducted to evaluate the interior quality of egg in four outbred F1 populations of Japanese quail.

2. Materials and Methods

2.1. Materials

This study used 200 black and brown Japanese quails consisting of four outbred F1 populations. They were raised under the same feed and management in the battery cage system. Quail feed used layer quail feed, and water was provided ad libitum. The equipment used was an individual cage with dimension 30 x 15 x 20 cm, feed and water container, electric bulbs (40 watts), digital scale, thermohygrometer, egg tray, digital calipers, depth micrometer, glass table, cup, and yolk color fan.

2.2. Methods

Preparatory activities included cage preparation and quail preparation. The cage preparation was included cage washing, liming, disinfection of the cage along with the feed and drinking containers and then placing the feed and drinking containers in the clean individual cage. Preparation of quail was done by outbreeding to produce four different strains. At the age of ten weeks, eggs were collected from laying quails to evaluate the egg interior characteristics.

Quail populations were constructed by four outbred mating system, i.e. male brown 1 and female black 2 (BL1), male brown 2 and female black 1 (BL2), male black 1 and female brown 2 (LB1), and male black 2 and female brown 1 (LB2). These lines represented treatments.

2.3. Research Parameters

The parameters observed in the study were egg interior quality. They were albumen height, albumen weight, albumen index, yolk weight, yolk height, yolk index, yolk color score, and HU value.

2.4. Data analysis

Data analysis was done by custom script written in the R programming language. The data obtained was tested for variance analysis (ANOVA), and 5% α (alpha) was set 0.05 in accordance to a completely randomized design (CRD) with quail lines as the factor. Shall the treatment show significant difference, the Duncan’s multiple range test or DMRT procedure was applied [11].

3. Results and Discussion

The results of egg interior quality in four outbred F1 populations of Japanese quail consisted of albumen height, albumen weight, albumen index, yolk weight, yolk height, yolk index, yolk color score, and the value of HU are summarized in Table 1.
3.1. Albumen Characteristics

The average values of albumen characteristics were presented in Table 1. Albumen weight was significantly different among outbred populations. LB populations were clearly higher albumen weight than BL populations (P<0.05). Other albumen traits were not different among lines.

The albumen index is a comparison between the albumen height and the average diameter of a thick albumen. The albumen index produced in this study was much higher than the literature, the quail’s albumen index was around 10.9% [8], 9.64% [10]. The index range for fresh quail albumen index was 0.05-0.17 [12]. The older the age of the egg the wider the albumen diameter so that the albumen index will be smaller. Changes in albumen are caused by gas exchange between the outside air and the contents of the egg through the eggshell pores and evaporation of water caused the duration of storage, temperature, humidity and porosity of the eggshell [13]. During storage, the thickness of the thick albumen will decrease rapidly then slowly. The albumen index will decrease by 40% in twenty hours at 32°C [14].

### Table 1. The average egg interior quality on black and brown Japanese quail

| Variable                  | BL1       | BL2       | LB1       | LB2       | P Value |
|---------------------------|-----------|-----------|-----------|-----------|---------|
| Albumen height (mm)       | 4.57±0.46 | 4.74±0.57 | 4.82±0.67 | 4.72±0.52 | 0.274   |
| Albumen weight (mm)       | 5.26±0.66b| 5.39±0.55b| 5.77±0.61a| 5.42±0.43b| <0.01   |
| Albumen index (%)         | 20.14±13.49| 20.91±13.42| 20.07±13.37| 19.99±12.78| 0.995   |
| Yolk weight (g)           | 2.84±0.42 | 2.94±0.32 | 2.99±0.29 | 2.83±0.33 | 0.141   |
| Yolk height (mm)          | 7.86±0.62a| 7.55±0.72b| 8.02±0.43a| 8.00±0.52a| <0.05   |
| Yolk index (%)            | 29.67±11.57 | 27.09±10.46 | 29.63±11.12 | 30.76±11.97 | 0.706   |
| Yolk color score          | 4.98±0.24 | 5.06±0.27 | 4.98±0.36 | 5.17±0.46 | 0.070   |
| Haugh unit                | 79.48±5.65 | 79.56±4.45 | 78.21±6.37 | 80.17±4.47 | 0.488   |

a,b,c Different superscripts in the same row show very real differences (P<0.05). Note: BL1= male brown VBC1><female black VBC2, BL2= male brown VBC2><female black VBC1, LB1= male black VBC1><female brown VBC2, and LB2= male black VBC2><female brown VBC1

3.2. Yolk Characteristics

The average yolk characteristics of yolk weight, yolk index, and yolk color score of brown and black quail eggs from different VBCs had not significant differences (P>0.05), whereas the yolk height had a significant difference (P<0.05), shown in Table 1. Based on statistical analysis, line treatment did not significantly affect the yolk weight, yolk index and color score of yolk and had a significant effect on yolk height. This showed that the four lines of treatment had the same yolk weight, yolk index, and yolk color score. The yolk height at the lowest BL2 treatment compared to BL1, LB1, and LB2 while for the BL1 treatment had the same yolk height with LB1 and LB2.

Yolk index is a comparison between yolk height and yolk diameter. Yolk index research results obtained were much lower than the literature that was the quail’s yolk index with dark brown feather color around 43.41% [10], the yolk index at 20 weeks is 43.22% [15]. Genetic factors of quail affect the index of eggs produced one of them hormones [16]. One way to measure the value of egg yolk quality was done by using the yolk index, was to compared the height with the diameter of the yolk. Measurement of the yolk index is relatively easier compared to albumen, because the shape of the yolk is relatively more stable than the albumen. Fresh egg yolk index ranges from 0.458 to 0.521 mm [17].

Yolk color score is used to determine the level of yolk color on eggs. The measurement of the yolk color score was done by matching the yolk color with the standard color found on the egg yolk fan or
egg yolk color fan. The higher the yolk color score, the better the yolk quality [18]. The yolk color score obtained in this study was higher than the literature was the 10-week quail’s yolk color score of around 4.45 [19] and lower than the opinion of [2] stated that the color score of quail’s yolk eggs was 7.6.

The color pigments in quail egg yolk are carotene and riboflavin which are classified as lipochromes, namely xanthophyll which make yolk reddish orange. The orange color in Yolk is due to the presence of carotenoids which contain a lot of zeaxanthin, cryptoxanthine and lutein or xanthophyll [13]. Factors that influence the yolk color, including strains, genetics, cage condition, disease, heat stress, xanthophyll oxidation and egg production [20].

3.3. Haugh Unit (HU) Value

The average Haugh Unit (HU) value of brown and black quail eggs from different VBCs had not significant differences (P>0.05), shown in Table 1. Based on statistical analysis, the strain treatment did not significantly influence the Haugh Unit value. This showed that all four lines of treatment had the same HU value.

The quail eggs from the results of the crossing in this study were included in the AA class because they had HU values > 79. The higher the HU value the better the egg quality. Haugh unit is a unit of value of albumen by calculating logarithmically the thick albumen height and transformed into the correction value of the egg function [21]. The higher the thickness of the albumen, the higher the HU value and the higher the egg quality [22]. Eggs with HU values > 79 include AA class, HU 79>U>55 including class A, HU 55>U>31 including B class, and HU value <31 including C class [21].

The HU value in this study was in line with the opinion of [23] stated that differences in Japanese quail varieties did not had a significant effect on HU values. HU values of black varieties were 80.15, brown was 79.81, and white was 78.69. The HU value produced in this study was lower than the literature at around 84.49 [24].

4. Conclusion

It can be concluded that the best interior quality of eggs were produced from male black quail VBC1 and female brown VBC2 in terms of albumen weight.

References

[1] Begum S, Yasemin M N, Morduzzaman M, Howlider M A R, Hossain M S 2016 *International Journal of Emerging Technologies in Engineering Research* 4:77-80
[2] Stojcic M D, Miloservic N and Peric L 2012 *Agronanje* 13:667-672
[3] Mienvielle F, Mills A D, Faure M, Faure J M, Monvoisin J L and Gourichon D 2002 *Poultry Science* 81:321-326
[4] Singh P N 2010 *Quail Production and Management Technology* (India: ICAR Research Complex for Goa)
[5] Warwick E J, Astuti J M and Hardjosubroto W 1990 *Pemuliaan Ternak* (Yogyakarta: Gadjah Mada University Press)
[6] Fibrianti S M, Suada I and Rudyanto M D 2012 *Indonesia Medicus Veterinus* 1:408-416
[7] Alawiyah I, Sujana E and Tanvirah W 2016 *Kualitas Eksterior Telur Puyuh (Coturnix-coturnix japonica) Turunan Hasil Persilangan Warna Bulu Coklat dan Hitam di Pusat Pembibitan Puyuh* (Bandung: Fakultas Peternakan Universitas Padjadjaran)
[8] Duman M, Sekeroglu A, Yildirim A, Eleroglu H and Camci O 2016 *European Poultry Science* 80:1-9
[9] Hassan A M, Mohammed D A, Hussein K N and Husein S H 2017 *Science Journal of University of Zakho* 5:296-300
[10] Inci H, Sogut B, Sengul T, Sengul A Y and Taysi M R 2015 *Brazilian Journal of Zootechnia* 44:390-396
[11] Steel R G D and Torrie J H 1991 *Principle and Procedure of Statistics* Second edition (McGraw-hill Book Company Aukland, Newzealand)
[12] Argo L B, Tristiarti and Mangisah I 2013 Animal Agricultural Journal 2:445-447
[13] Yuwanta T 2010 *Telur dan Kualitas Telur* (Yogyakarta: Gadjah Mada University Press)
[14] Romanoff A L and Romanoff A J 1963 *The Avian Egg* 2nd Edition (New York: John Wiley and Sons)
[15] Hrncar C, Hanusova E, Hanus A and Bujko J 2014 Slovak Journal of Animal Science 47:6-11
[16] Kusumastuti D T, Praseno K and Saraswati T R 2012 *Jurnal Biologi* 1:15-22
[17] Badan Standarisasi Nasional (BSN) *Telur Ayam Konsumsi* (Jakarta: Badan Standarisasi Nasional)
[18] Muharlien 2010 *Jurnal Ilmu dan Teknologi Hasil Ternak* 5:32-37
[19] Nagarajan S, Narahari D, Jayaprased I A and Thyagarajan D 1991 British Poultry Science 32:243-248
[20] North M O and Bell D D 1990 *Commercial Chicken Production Manual* 4th Edition (Van Nostrand)
[21] Yuwanta T 2007 *Telur dan Produksi Telur* (Yogyakarta: Gadjah Mada University Press)
[22] Stadelman W J and Cotteril O J 1995 *The Egg Science and Technology* 2nd Edition (Westport: Avi. Publishing Co. Inc)
[23] Chimezie V O, Fayeye T R, Ayorinde K L and Adebunmi A 2017 Agrosearch 17:44-53
[24] Song K T, Choi S H, Oh H R 2000 *Asian Australasian Journal of Animal Science* 13:986-990