p-ISSN 1410-5659 e-ISSN 2621-5144 **Jurnal Ilmu Ternak Universitas Padjadjaran, December 2024, 24(2):136-143**
Published by: DOI: 10.24198/jit.v24i2.58314
Unpad Press Available online at http://jurnal.unpad.ac.id/jurnalilmuternak

THE RELATIONSHIP BETWEEN BODY WEIGHT AND EGG WEIGHT OF PADJADJARAN QUAILS OF LAYER AND BROILER TYPES

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Abstract

The egg weight is one of the phenotypic traits that can be inherited in poultry, as eggs produced by different birds will have distinct shapes and colors, corresponding to the shape and size of their reproductive tract. Generally, the factors influencing egg size and weight are genetic. However, other factors can also affect egg weight, with one of the key factors being body weight. Thus, it is essential to understand the strength of the relationship between body weight and egg weight, as this can impact both the quality and quantity of eggs produced by quails. This study investigates the relationship between body weight and egg weight in both Padjadjaran layer and broiler quails, along with the nature and strength of said relationship. This research was conducted at the Quail Breeding Center, Faculty of Animal Husbandry, Universitas Padjadjaran. This research involved 100 female quails from 50 layers and 50 broiler quails, all of which were 15 weeks old, along with their eggs. A correlational method was employed for the analysis. The findings revealed a strong correlation between body weight and egg weight in Padjadjaran layer quails, indicated by a correlation coefficient of 0.792. The relationship was represented by the regression equation ($y = 0.0586x + 0.8429$), which had a relatively high coefficient of determination (R^2) of 0.6281. Conversely, the results for Padjadjaran broiler quails indicated a weak correlation, with a correlation coefficient of 0.374. The regression equation for broiler quails was ($y = 0.0145x + 8.0157$), with a low coefficient of determination (R^2) of 0.1402. In conclusion, the study identified a strong correlation between body weight and egg weight for Padjadjaran layer quails, and a weak correlation was observed for Padjadjaran broiler quails. Furthermore, the regression equation for predicting egg weight based on body weight is reliable for Padjadjaran layer quails but not applicable to the broiler quails, as the low determination value suggests that the regression model for broiler quails is insufficient for such predictions.

Keyword: Padjadjaran Layer Quails, Broiler Quails, Body Weight, Egg Weight.

HUBUNGAN ANTARA BOBOT BADAN DENGAN BOBOT TELUR PUYUH PADJADJARAN TIPE PETELUR DAN PEDAGING

Abstrak

Berat telur merupakan salah satu sifat fenotipe yang dapat diwariskan pada unggas, karena telur yang dihasilkan oleh berbagai jenis unggas akan memiliki bentuk dan warna yang berbeda, sesuai dengan bentuk dan ukuran saluran reproduksinya. Umumnya, faktor yang memengaruhi ukuran dan berat telur bersifat genetik. Namun, faktor lain juga dapat memengaruhi berat telur, dengan salah satu faktor kunci adalah berat badan. Oleh karena itu, penting untuk memahami kekuatan hubungan antara berat badan dan berat telur, karena hal ini dapat memengaruhi kualitas dan kuantitas telur yang dihasilkan oleh burung puyuh. Penelitian tentang hubungan antara berat badan dan berat telur pada puyuh Padjadjaran, baik jenis petelur maupun pedaging, dilakukan di Pusat Pembibitan Puyuh Fakultas Peternakan Universitas Padjadjaran. Tujuan utama penelitian ini adalah untuk mengkaji kekuatan dan sifat hubungan antara berat badan dan berat telur pada puyuh tersebut. Penelitian ini melibatkan 100 ekor puyuh betina, yang terdiri dari 50 ekor dari setiap jenis, yang semuanya berusia 15 minggu, beserta telurnya. Metode korelasional digunakan untuk analisis data. Hasil penelitian menunjukkan adanya korelasi yang kuat antara berat badan dan berat telur pada puyuh petelur Padjadjaran, yang ditunjukkan dengan koefisien korelasi sebesar 0,792. Hubungan tersebut direpresentasikan oleh persamaan regresi ($y = 0,0586x + 0,8429$), yang memiliki koefisien determinasi yang relatif tinggi (R^2) sebesar 0,6281. Sebaliknya, hasil untuk puyuh pedaging Padjadjaran menunjukkan korelasi yang lemah, dengan koefisien korelasi sebesar 0,374. Persamaan regresi untuk puyuh pedaging adalah ($y = 0,0145x + 8,0157$), yang menunjukkan koefisien determinasi yang rendah (R^2) sebesar 0,1402. Sebagai kesimpulan, penelitian ini mengidentifikasi korelasi yang kuat antara berat badan dan berat telur untuk puyuh petelur Padjadjaran, sedangkan korelasi yang lemah diamati untuk puyuh pedaging Padjadjaran. Lebih lanjut, persamaan regresi untuk memprediksi berat telur berdasarkan berat badan dianggap andal untuk puyuh petelur Padjadjaran tetapi tidak berlaku untuk puyuh pedaging, karena nilai determinasi yang rendah menunjukkan bahwa model regresi untuk puyuh pedaging tidak cukup untuk prediksi tersebut.

Kata kunci: Puyuh Petelur Padjadjaran, Puyuh Pedaging, Berat Badan, Berat Telur

INTRODUCTION

Quails are a type of poultry that has been domesticated for a long time and are widely distributed across Indonesia. Quails serve as an alternative source of animal protein for communities, both as egg and meat producers. The most commonly bred quail species in Indonesia is the Japanese quail (*Coturnix coturnix japonica*), primarily raised for egg production, and the Malon quail, which is raised for meat due to its relatively larger body size compared to other local quail varieties (Marsudi and Cahyono, 2012). The Malon quail, derived from the abbreviation "Manuk Londo," is a hybrid breed resulting from the cross between the local quail (*Coturnix coturnix javonica*) and the French quail (*Coturnix c. Coturnix*). One of the critical factors in the success of quail farming is the quality of the breeding stock.

Successful quail farming is determined by its access to high-quality breeding stock, quality feed, and effective management. To ensure the availability of high-quality breeding stock, the Faculty of Animal Husbandry at Universitas Padjadjaran has developed the Padjadjaran quail of layer and broiler types. The Padjadjaran quail is the result of research at the Quail Breeding Center of Universitas Padjadjaran since 2014. The breeding activities for Padjadjaran quails follow a well-structured and systematic breeding pattern (through multi-generational selection) to produce high-quality stock. The breeding model for Padjadjaran layer quails involves crossing pure brown and black lines that exhibit high productivity and auto-sexing traits at day-old quails (DOQ). The Padjadjaran broiler quails are produced from selected Malon and Japanese quails, specifically bred for meat production. The Padjadjaran quails, both layer and broiler types, are expected to be a solution for the supply of superior quail breeding stock, which is currently in very limited availability.

Wiesje and Rajab (2015) explain that egg weight is one of the phenotypic traits that can be inherited in poultry, as eggs produced by different birds will have distinct shapes and colors, corresponding to the shape and size of their reproductive tract. While genetic factors primarily influence egg size and weight, other factors, such as body weight, can also affect them. Thus, it is essential to understand the strength of the relationship between body weight and egg weight, as this can impact both the quality and quantity of eggs produced by quails. Moreover, specific research conducted on Padjadjaran quail, egg-laying, and meat-breeding types, has never been conducted.

Based on this premise, the authors conducted a study to examine the relationship between body weight and egg weight in Padjadjaran layer and broiler quails.

MATERIAL AND METHOD

Animals

The materials used in this study include Padjadjaran layer and broiler quails, and the eggs produced by 24-week-old breeders kept at the Quail Breeding Center, Faculty of Animal Husbandry, Universitas Padjadjaran. A total of 100 female quails were used, comprising 50 Padjadjaran broiler quails and 50 Padjadjaran layer quails.

Housing

Housing used an individual cages or battery cage systems with open cages, with each cage measuring 25 cm long, 20 cm wide, and 30 cm high. A total of 100 cages were used, with the floor and walls made of wire mesh and the roof made of plywood. The floor was sloped to facilitate egg collection. The bottom of the cages was lined with plywood to facilitate the collection of waste.

Research Equipment

The equipments used in this study include:

(1) Writing Tools: to record research data.
(2) Egg Tray: to store the eggs.
(3) 8-Megapixel Smartphone Camera: to document research activities.
(4) Marker Pen: to label the eggs.
(5) Digital Scale: to weigh the quails and eggs.
(6) Laptop: to store and process measurement data

Research Method

The research method used descriptive was a correlational approach with regression and correlation analysis. Data collection involved weighing the body weight and egg weight of the Padjadjaran layer and broiler quails.

Procedures

The procedures for conducting this study included:

(1) Prepare by cleaning the quail cages.
(2) Place the quails into the battery cage according to the research specifications.
(3) Provide feed rations every morning and evening. The ration used in quail maintenance at the Padjadjaran University Breeding Center in the layer phase is a crumble ration. *(Table 1)*
(4) Supply drinking water *ad libitum*.
(5) Observe the quail. If any lay eggs, collect the eggs.
(6) Clean any collected dirty eggs.
(7) Weight the quail and their eggs using a digital scale.
(8) Mark each egg with the corresponding cage number for identification.
(9) Record the weights of the quail and eggs.

Observed Variables

The variables observed in the study of the relationship between body weight and egg weight in Padjadjaran layer and broiler quails are as follows:

(1) Body Weight (grams)
Body weight is measured by weighing the quails using a digital scale.
(2) Egg Weight (grams)
Egg weight is measured by weighing the eggs using a digital scale.

Statistical Analysis

Data analysis was carried out descriptively consisting of::

1. The average calculated is the number obtained from the total number of suspensions divided by the total data

$$\bar{x} = \frac{\sum_{i=1}^{n} xi}{n}$$

Notes :
$\bar{x}$ = Average
n = amount of data
x_i = Data x no i

2. Maximum value, or the largest data value after the data was sorted
3. Minimum value, or the smallest data value after the data is sorted Standard Deviation. The standard deviation is the square root of variance, which is calculated by summing the squares of all deviations of individual values from the population mean.
4. Coefficient of Variation. The coefficient of variation is a measure that shows the magnitude of the diversity value of the variable measurement data. The coefficient of variation does not depend on the units used, therefore it can be used to compare the relative variations of several data sets of different units.

Correlation Analysis

Correlation refers to the close relationship between two or more variables, represented by the degree of closeness or the level of association between them. The strength of this relationship can be measured using the correlation method, specifically the correlation coefficient \(r \). The formula for calculating the correlation coefficient (r) is as follows:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2]\,[n\sum y^2 - (\sum y)^2]}}$$

Notes:

N	=	Number of pairs of data X and Y
Σx	=	Total Number of Variable X
Σy	=	Total Number of Variable Y
Σx^2	=	Square of the Total Number of Variable X
Σy^2	=	Square of the Total Number of Variable Y
Σxy	=	Product of the Total Number of Variable X and VariableY

To find the significance, the correlation coefficient between body weight and quail egg weight was tested using a formula: *(Table 2)*

$$t\ hit = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Notes :

r	=	Correlation coefficient value
n	=	Number of samples

Regression Analysis

The analysis used to obtain the relationship between body weight and egg weight was using regression analysis (Hasan, 2001). In order to find a model for estimating egg weight based on body weight which was estimated using the most appropriate regression analysis model, the most appropriate model was determined based on the regression model which has the largest coefficient of determination (^{R2}) with the smallest standard error. Data analysis used the SPSS ver. 11 program.

Table 1. Nutrient content of quail rations used during research

Nutrient	Quantity
Water content (max) %	13
Protein %	23,5
Fat (min) %	5
Crude fiber (max) %	5
Ash (max) %	7
Calsium (min) %	0,9
Phosphorus (min) %	0,6
Metabolic Energy (kcal/kg)	3000-3100

Source: PT. Charoend Pokphand Indonesia

Table 2. Interpretation of Correlation Coefficient Values

No	Meaning	Value
1	> 0,00 - 0,199	Very low
2	> 0,20 - 0,399	Low
3	> 0,40 - 0,599	Medium
4	> 0,60 - 0,799	Strong
5	> 0,80 - 1,00	Very Strong

Source: Sugiyono (2005)

RESULTS AND DISCUSSION

Body Weight of Laying and Broiler Padjadjaran Quail

The results showed that the smallest laying quail's body weight was 143 grams, its highest body weight was 211 grams, and the average body weight was 173.62 grams, with a standard deviation of 13.79 and a coefficient of variation of 7.94%. Furthermore, the smallest Padjadjaran Broiler quail body weight was 272 grams, the largest body weight was 374 grams, and the average body weight was 324.22 grams with a standard deviation of 22.803 and a coefficient of variation of 6.941%. The body weight of the Padjadjaran quail, both layers and broilers used during the study, was relatively uniform because the coefficient of variation was smaller than 10%. A population is considered uniform if it has a coefficient of variation smaller than 10% (Sudjana, 2005).

The results of research on laying Padjadjaran quail showed that the body weight of the quail was 143-211 grams with an average of 173.62 grams. The results of this study were higher than the research of Setiawan (2006) which stated that the body weight of Coturnix coturnix japonica quail ranged from 127.0-143. 7 grams with an average of 135.53 grams. Other observations were made regarding the average weight of a female laying quail of around 150 grams and reaching peak production of more than 80% in the 13th week (Tetty, 2002). The body weight of female quail continues to increase after entering the egg-laying period and is mostly stable at a weight of 120-130 or 140-150 grams (Arora and Samples, 2011). The body weight of adult female quail ranges from 140-160 g per head. According to Nugraeni (2012), quail that have entered sexual maturity have relatively constant body growth. Kartadisastra (1997) asserts that the body weight of livestock is directly proportional to feed consumption; as body weight increases, feed consumption also rises.

The results of the research on Padjadjaran broiler quail were not much different from the Pasadena *et al*. (2016) research on the second generation of broiler quail, with body weights ranging from 212.00-398.00 grams, and an average of 325.35 ± 48.29 grams. Poultry growth was influenced by genetic factors, where each animal has different growth abilities based on age and gender. Anggorodi (1995) explains that growth starts slowly then quickly and in the final stage it slowly returns and then stops completely. It was explained further regarding the factors that influence poultry growth, including nutritional factors which include energy, protein, vitamins,

minerals and calcium so that if the bird's weight increases every week, the protein levels will also increase.

Padjadjaran Quail Egg Weights Laying and Broilers

The results of the analysis of the egg weight of laying Padjadjaran quail showed that the smallest egg weight was 9.0 grams, while the largest egg weight was 13.2 grams and the average egg weight was 11.01 with a standard deviation of 1.02 and a coefficient of variation of 9.26%. This result shows that the egg weight is uniform with a coefficient of variation below 10%. From the results of this research, it was found that the average egg weight was 11.01 grams. This aligns with the findings of Listiyowati and Roospitasari (2003), who reported that the average weight of quail eggs is approximately 10-11 grams per egg.

The results of the analysis carried out on the weight of Padjadjaran Broiler quail eggs showed that the smallest egg weight was 11.1 grams, while the largest egg weight was 14.4 grams and the average egg weight was 12.722 grams with a standard deviation of 0.883 and a coefficient of variation of 6.941%. The egg weight is classified as uniform because the coefficient of variation is less than 10% (Sudjana, 2005). North and Bell (1990) noted that variations in egg weight are typically consistent only in double yolk and other abnormal eggs. Several factors contribute to variations in egg weight, including the natural patterns of egg production, the effects of feed and management, as well as genetic factors. The results of this study are not much different from research by Azizat (2017), regarding egg weight, where the average weight of broiler quail eggs was 12.75 ± 0.615 g. According to Triyanto (2007), egg weight increases with increasing age. Nugroho and Manyun (1986) stated that quail eggs at the start of laying are small, the size of the eggs increases with age and will reach a stable size.

Egg weight is a quantitative characteristic that can be determined by the type of feed, cage environment, and body size of the parent which greatly influence egg weight. Apart from that, egg weight is also greatly influenced by the laying period. Wiesje and Rajab (2015) explained that egg weight is one of the positive characteristics that can be inherited in poultry, because eggs produced by different birds will have distinctive shapes and colors according to the shape and size of their reproductive tract. According to Noor (2000), the heritability value of egg weight is 0.60, indicating that egg weight is a highly inheritable trait from the parent. Additionally, Etches (1996) reported that the heritability value of egg weight ranges from approximately 0.45 to 0.85, further emphasizing its strong genetic influence.

Table 3. Body Weight of Laying and Broiler Padjadjaran Quail

Value	Bodyweight	
	Laying Quail	**Broiler Quail**
Minimum (gram)	143	272
Maximum (gram)	211	374
Averages (gram)	**173,62**	**324,44**
Standard Deviation (gram)	13,79	22,803
Coeficient Variation (%)	**7,94**	**7,028**

Table 4. Padjadjaran Quail Egg Weights Laying and Broilers

Value	Egg Weights	
	Laying Quail	**Broiler Quail**
Minimum (gram)	9,0	11,1
Maximum (gram)	13,2	14,4
Averages (gram)	**11,010**	**12,722**
Standard Deviation (gram)	1,020	0,883
Coeficient Variation (%)	**9,26**	**6,941**

Correlation between Body Weight and Egg Weight in Laying and Broiler Padjadjaran Quail

The results of the analysis regarding the close relationship between body weight and egg weight in laying Padjadjaran quail were positively correlated with a value of 0.792. This correlation coefficient value is included in the strong correlation category. These findings are in accordance with the statement by Campbell et al., (2003), that body weight has a high correlation with egg weight, as larger weight will produce larger eggs too. According to Etches (1996), there is a high correlation between hen body weight and egg weight, where hens with larger body weights produce larger eggs while smaller hens produce smaller eggs. Similarly, Hamdan (2005) stated that high egg weight results from high body weight in livestock

Furthermore, the results of the analysis regarding the close relationship between body weight and egg weight of Padjadjaran Broiler quail show that the correlation coefficient (r) is equal to 0.374. This means that the two have a low positive correlation. The results of the significance test obtained a calculated t value of 3.431 and a t table value with α = 5% was 2.011, and as the calculated t value (3.431) > t table (2.011), it can be concluded that there is a relationship between body weight and quail egg weight Padjadjaran Broiler. This result is different from the results of research by Mielenze et al, (2006) on laying quail, where the correlation between body weight and egg weight was 0.59. This is due to the difference in body weight between Meat Padjadjaran quail and Laying Padjadjaran quail, which causes differences in their reproductive tracts. According to Yuwanta (2004), this difference is caused by several factors including genetics, diet, disease, age and production of eggs, while according to Neil (1991), this difference is due to differences in the growth and performance of the birds.

Regression between Body Weight and Egg Weight in Laying and Broiler Padjadjaran Quail

In order to find a model for estimating egg weight based on body weight which is estimated using the most appropriate regression analysis model, the most appropriate model is determined based on the regression model which has the largest coefficient of determination (R^2) with the smallest standard error. Regression analysis is used to describe the form of relationship between two or more variables, especially to explore relationship patterns whose models are not yet completely known. Regression analysis itself aims to estimate the value of a variable (dependent variable) if the values of other variables related to it have been determined.

Based on the collected data, the analysis was performed using a simple linear regression model, which is represented by the following formula: $\hat{Y} = a + b$ From the calculation results, it is found that the equation is $\hat{Y} = 0.8429 + 0.0586X$. The regression equation yields a positive value, indicating a positive relationship between body weight and egg weight in laying Padjadjaran quails. This suggests that for every one-gram increase in body weight (x), there is a corresponding increase in egg weight of 0.058 grams.

The coefficient of determination (R^2) is utilized to assess the extent of the contribution of variable X to variable Y (Ridwan, 2010). The obtained value was 0.6281 or 62.81, meaning that the influence of body weight (X) on egg weight (Y) was 62.81% with the remaining 37.19% determined by other factors. Lisyowati and Roospitasari (2005) added several factors that influence egg weight, including the amount of feed, quality of feed, type of feed and cage environment.

From the calculation results, the obtained regression equation was $\hat{Y} = 0.80157 + 0.0145X$. This equation shows a positive value, which means there is a positive relationship between body weight and egg weight in laying Padjadjaran quail. This relationship can be interpreted as that every gram increase in body weight (x) is followed by an increase in weight of 0.0145 g. The coefficient of determination (R2) is used to calculate the size of the contribution of variable X to variable Y (Ridwan, 2010). The obtained value was 0.1402 or 14.02%, meaning that the influence of body weight (X) on egg weight (Y) was 14.02% with the remaining 85.98% determined by other factors. The coefficient of determination value is too low below 50%, so body weight cannot be used to estimate the weight of Padjadjaran broiler quail eggs.

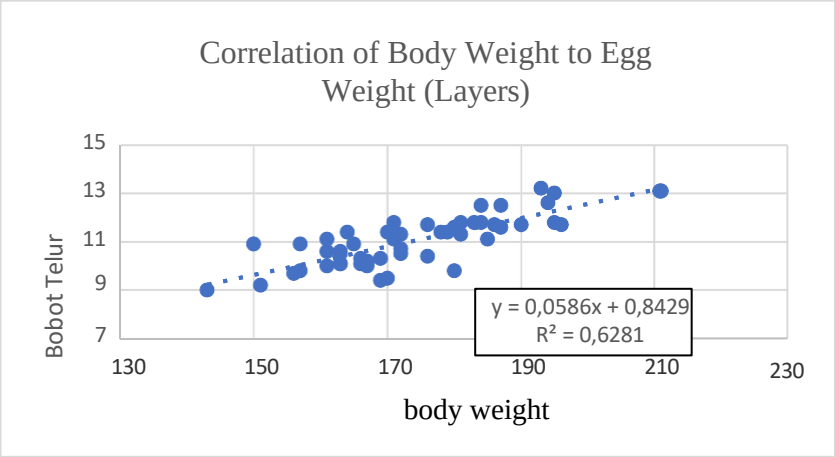

Illustration 1. Linear regression diagram of the relationship between body weight and egg eight in Padjadjaran layer quails.

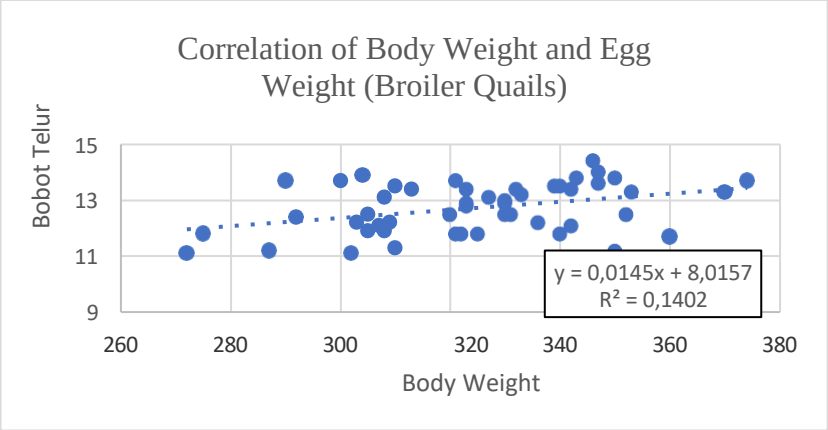

Illustration 2. Linear regression diagram of the relationship between body weight and egg weight in Padjadjaran broiler quails.

CONCLUSION

(1) The relationship between body weight and egg weight in laying quails is strong, with a correlation coefficient of 0.792. The equation representing the relationship between body weight and egg weight in laying Padjadjaran quails is $\hat{Y} = 0.948 + 0.058X$, accounting for other factors.

(2) The relationship between body weight and egg weight in Padjadjaran broiler quails is weak, with a correlation coefficient of 0.374. The coefficient of determination (R^2) for the relationship between body weight and quail egg weight across all regression models is too low, indicating that body weight cannot be reliably used to estimate egg weight.

REFERENCES

Anggorodi, H. R. (1995). Nutrisi Aneka Ternak Unggas. Jakarta: Gramedia Pustaka Umum.

Arora, K. L. & O. Samples. (2011). Role or Body Weight on Reproductive and Physiological Traits in Japanese Quail Layers (Coturnix japonica). *Int. J. Poultry Sci*. 10 (8): 640-643.

Azizat, M. H. (2017). *Karakteristik Eksterior Telur Tetas Puyuh Malon Generasi Ketiga Di Pusat Pembibitan Puyuh Fakultas Peternakan Universitas Padjadjaran.* Skripsi Fakultas Peternakan Universitas Padjadjaran.

Campbell, J. R., M. D Kenealy & K. L. Campbell. (2003). *Animal Science, The Biology,Care and Production of Domestic Animals.* 4 th Ed. Mc. Graw Hill. New York.

Etches, R.J. (1996). Reproduction in Poultry. CAB International. University Press, Cambridge.

Hamdan. (2005). Direct and Correlated Responses of Growth and Production Traits in Japanese Quail Following Long-Term Selection. *Jurnal Agribisnis Peternakan*, 1 (1). Fakultas Pertanian Universitas Sumatera Utara. Medan.

Hasan, M.I. (2001). *Pokok–Pokok Statistik 1*. Bumi Aksara, Jakarta.

Kartadisastra, H. R. (1997). *Penyediaan dan Pengolahan Pakan Ternak Ruminansia*. Kanisius, Yogyakarta

Listiyowati, E. dan Roospitasari, K., (2003). *Puyuh Tata Laksana Budi Daya Secara Komersial*. Penebar Swadaya, Jakarta.

Mielenz N, Noor RR, Schüler L, 2006. *Estimation of Additive and Non-Additive Genetic Variances of Body Weight, Egg Weight and Egg Production for Quails (Coturnix coturnix japonica) With an Animal Model Analysis.* Archiv Tierzucht 49(3): 300-307.

Neil, A. C. (1991). Biology 2nd edition. The Benjamin Coming Publishing Company Inc. Pec Wood City.

Noor, R, R. (2000). *Genetika Ternak*. Penebar Swadaya. Bogor.

North, M.O dan D.D. Bell. (1990). *Commercial Chicken Production Manual*, 4 th Edit. Chapman and bHall, New York USA.

Nugraeni, D. W., (2012). *Persentase Karkas dan Daging Puyuh (Coturnix-coturnix japonica) Afkir Pada Kepadatan Kandang yang Berbeda*. Fakultas Peternakan. Institut Pertanian Bogor. Bogor.

Pasadena, O., E. Sujana dan I. Setiawan, (2016). *Identifikasi Sifat Kualitatif dan Kuantitatif Puyuh Malon Betina Dewasa*. http://jurnal.unpad.ac.id/ejournal/article/view/10206/4635.

Setiawan, D. (2006). *Performa Produksi Burung Puyuh (Coturnix coturnix japonica) Pada Perbandingan Jantan dan Betina yang Berbeda*. Fakultas Peternakan. Institut Pertanian Bogor. Bogor.

Sudjana. (2005). *Metode Statistika Edisi ke-6*. Bandung : Tarsitona. 2002. *Metode Statistika*. Bandung: Tarsito.

Tetty. (2002). *Puyuh Si Mungil Penuh Potensi*. Agro Media Pustaka. Jakarata.

Triyanto. (2007). Performa produksi burung puyuh (Coturnix coturnix japonica) periode produksi umur 6-13 minggu pada lama pencahayaan yang berbeda. Institut Pertanian Bogor.

Wiesje, M. H., dan Rajab. (2015). *Identifikasi Jenis Kelamin Anak Ayam Buras Berdasarkan Bobot dan Indeks Telur Tetas Berbeda*. Jurnal Agrinimal, Vol. 5, No. 1. Fakultas Pertanian, Universitas Pattimura. Ambon

Yuwanta Tri. (2004). *Dasar ternak Unggas*. Kaninus, Yogyakarta.