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Correlation Between Egg Production Performance of Sikumbang Jonti Ducks as a Selection Method in Smallholder Farms

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ABSTRACT

This study aims to determine the diversity and correlation of egg production performance in Sikumbang Jonti ducks as a basis for making selection decisions. The materials used were 47 female Sikumbang Jonti ducks. In the production phase, Sikumbang Jonti ducks were intensively reared in individual battery cages for 24 weeks. The observed variables were body weight (g), age at first laying (days), egg production (eggs), and egg weight (g). Data on body weight, age at first laying, total egg production, and egg weight were analyzed descriptively by calculating the mean value, standard deviation, coefficient of variation, minimum value, and maximum value. Furthermore, data on body weight, age at first laying, egg production, and egg weight were also analyzed for correlation to see the direction and relationship between variables. The results of this study were that Sikumbang Jonti ducks have an average body weight of 1299g, age at first egg laying of 170.19 days, average total egg production of 36.62 eggs, and average egg weight of 59.06g. The diversity of body weight, age at first egg laying, and egg weight of Sikumbang Jonti ducks are moderate, while the diversity of egg production is high. The diversity of body weight, age at first laying, and egg weight of Sikumbang Jonti ducks are included in moderate diversity. In contrast, the diversity of egg production is included in high diversity. Based on the correlation of body weight, age at first laying, egg production, and egg weight of Sikumbang Jonti ducks, age at first laying is the selection variable that can be used as a good predictor of egg production performance. In conclusion, the study results show that a longer age of first laying can be used as a selection variable to increase the production and egg weight of Sikumbang Jonti ducks.

Keywords: Local ducks, Germplasm, Potential, West Sumatra, Domesticated poultry

INTRODUCTION

Sikumbang Jonti ducks are one of the local ducks in West Sumatra Province, originating from Payakumbuh Timur District, Payakumbuh City. Sikumbang Jonti ducks have white feathers, except for the green primary wing and black tail feathers (Arlina et al., 2021). Male Sikumbang Jonti ducks have black head feathers, while female Sikumbang Jonti ducks have white head feathers, making it easier for farmers to sex Sikumbang Jonti ducks as adults. In addition, Sikumbang Jonti ducks also have advantages such as tolerance to hot environments (Subekti et al., 2019) and high body weight compared to other local ducks with close habitat, such as Pitalah ducks (Yurnalis et al., 2017) and Bayang ducks (Yurnalis et al., 2019). Thus, Sikumbang Jonti ducks are local ducks with the potential to be broiler ducks.

On the other hand, the high meat production of Sikumbang Jonti ducks has led to the low population of Sikumbang Jonti ducks in their habitat. Farmers only cut Sikumbang Jonti ducks for meat production without considering their population. So, at this time, duck farmers have difficulty getting Sikumbang Jonti ducklings. This follows the opinion of Husmaini et al. (2024), who state that the Sikumbang Jonti duck population is very low in its natural habitat.

Based on the above, it is necessary to maintain the availability of Sikumbang Jonti ducklings; one way is by selection. The selection can be made by looking at the egg production traits of female Sikumbang Jonti ducks because they affect the availability of seedlings. Egg production traits such as body weight, age at first egg laying, egg production, and egg weight can be observed. This follows the statement of Matitaputty and Bansi (2018): duck egg production performance can be seen from daily egg production (%), egg weight (g), age at first laying (days), and weight at first laying (g). Matitaputty and Bansi (2018) also added that egg production performance is one of the essential

traits of economic value because it is related to price. This is also supported by the results of research by Susanti and Kumalawati (2019) and Rajkumar et al. (2021), which indicate that selection activities can increase duck egg production and are indicated by the selection response to improve egg production performance.

On the other hand, Sikumbang Jonti ducks in Payakumbuh City are mostly farmed by smallholder farms, so the selection method that can be done does not require too much cost. One of the selection methods that farmers can use on a small scale is the correlation method. This follows the statements of Rajkumar et al. (2020) and Zhu et al. (2021) that the number and direction of correlation responses can be used as an effective selection strategy to increase productivity, especially on positively correlated variables. Variables that correlate with egg production performance are body weight and age at first egg laying. The results of Raziq et al. (2024) stated that body weight and age at first laying can affect egg production performance. Masti et al. (2021) also added that production performance (growth) can affect reproductive performance (egg production) in ducks. In addition, Abigaba et al. (2024) also added that quantitative characteristics can be used to predict livestock reproductive performance.

MATERIALS AND METHODS

Materials

The tools used in this study were digital scales. The research animals used were 47 female Sikumbang Jonti ducks. The research feed used during maintenance was commercial laying duck feed.

Methods

This study was an exploratory study using female Sikumbang Jonti ducks intensively reared in individual battery cages for 24 weeks in the production phase. Feed layer duck (D93® PT. New Hope) was given twice daily, totaling 160 grams/head/day. Drinking water was given *adlibitum*. The observed variables were body weight (g), age at first egg laying (days), egg production (eggs), and egg weight (g).

a) Body weight (g): Body weight is determined by weighing the ducks at 19 weeks.
b) Age at first egg laying (days): Age at first egg laying was determined by calculating the age at which the ducks first laid eggs from the first day the ducks hatched.
c) Egg production (eggs): Egg production was calculated by summing the egg production of each duck during the study.
d) Egg weight (g): Egg weight was calculated by summing the weight of eggs during the study and dividing it by the number of eggs.

Data on body weight, age at first laying, egg production, and egg weight were analyzed descriptively by calculating the mean value, standard deviation, coefficient of variation, minimum value, and maximum value using the formula suggested by Noor (2008):

$$\bar{x} = \frac{\sum x}{n}$$

$$s = \sqrt{\frac{(\Sigma x - \bar{x})^2}{n - 1}}$$

$$CV = \frac{s}{\bar{x}} \times 100$$

Description:
$\bar{x}$ = average value of the variable
x = variable value
n = number of individual chickens in one group
s^2 = variance value
s = standard deviation value
CV = coefficient of variation

Furthermore, correlation analysis was conducted using the Pearson correlation coefficient to determine the strength and direction of the relationship between variables and then tested for significance.

RESULTS AND DISCUSSION

Egg Production Performance of Sikumbang Jonti Ducks

The results of the study in the form of body weight (g), age at first egg laying (days), egg production (eggs), and egg weight (g) in Sikumbang Jonti ducks during the study are presented in Table 1. A picture of Sikumbang Jonti ducks used during the study is presented in Fig. 1.

The average body weight of Sikumbang Jonti ducks (1299g) in this study was lower when compared to the body weight of Sikumbang Jonti ducks from Husmaini et al. (2024) and Arlina et al. (2021), which amounted to 1392g and 1360g, respectively. The body weight of Sikumbang Jonti ducks is also lower than other local Indonesian ducks, such as Mojosari ducks, which have an average body weight of 1385g (Aminuddin et al., 2019), and Magelang ducks, which have an average body weight of 1620g (Dewi et al., 2017).

(a) (b)

Fig 1. Male Sikumbang Jonti ducks (a) and female Sikumbang Jonti ducks (b)

The results showed that the body weight of Sikumbang Jonti ducks had an average body weight value of 1299g, with the highest body weight of 1633g and the lowest body weight of 1019g. Sikumbang Jonti ducks also have an average age of first egg laying of 171 days, with the fastest age of first egg laying being 154 days and the longest being 211 days. The average egg production of Sikumbang Jonti ducks at 24 weeks of age was 50.95 eggs, with the highest total production of 78 eggs and the lowest total production of 5 eggs. Finally, the average egg weight of Sikumbang Jonti ducks during the study was 59.06g, with the heaviest egg weight being 71.18g and the lightest being 47.80g.

Table 1. Egg production performance of Sikumbang Jonti ducks during the study

Variable	Means	s	CV (%)	Min	Max
Body weight (g)	1299	149.45	11.51	1019	1633
Age at first egg laying (days)	170.19	11.41	6.70	154	211
Egg production (eggs)	36.62	22.45	61.31	5	78
Egg weight (g)	59.06	5.73	9.71	47.80	71.18

Furthermore, based on the results of the study, the production performance of Sikumbang Jonti ducks has a coefficient of variation in body weight of 11.51%, age at first egg laying of 6.70%, egg production of 61.31%, and egg weight of 5.73%.

Correlation of egg production performance of Sikumbang Jonti Ducks

The correlation results of each production performance of Sikumbang Jonti ducks during the study are presented in Table 2. The results showed that the body weight of Sikumbang Jonti ducks was not correlated (P>0.05) with age at first laying, egg production, and egg weight. Furthermore, age at first egg laying was negatively correlated (P<0.05) with egg production and not correlated (P>0.05) with egg weight. Finally, egg production was positively correlated (P<0.05) to egg weight.

Table 2. Correlation of egg production performance of Sikumbang Jonti ducks

Variable	Body weight (g)	Age at first egg laying (days)	Egg production (eggs)	Egg weight (g)
Body weight (g)	1.00	-0.24	0.18	0.26
Age at first egg laying (days)	-0.24	1.00	-0.33*	0.05
Egg production (eggs)	0.18	-0.33*	1.00	0.48*
Egg weight (g)	0.26	0.05	0.48*	1.00

*: Correlation is significant at the 0.05 level;
-: negative correlation

In addition, Sikumbang Jonti ducks also have lower body weights when compared to local Chinese ducks, such as Jinling White ducks, which have an average body weight of 1888g (Zhang et al., 2024), Domyati ducks, which have an average body weight of 1667 g, Khaki-Campbell ducks which have an average body weight of 2218g (El-Deghadi et al., 2022), and Shan-ma ducks which have an average body weight of 1269g (Lin et al., 2016). Finally, Sikumbang Jonti ducks also have a lower average body weight than local Kazakhstan ducks, with an average body weight of 2581g (Saginbayeva et al., 2024).

However, based on research by Yurnalis et al. (2017) and Yurnalis et al. (2019), the body weight of Sikumbang Jonti ducks is higher when compared to the body weight of Pitalah ducks and

Bayang ducks (local ducks of West Sumatra, Indonesia) under the same environmental conditions and age. In addition, the body weight of Sikumbang Jonti ducks is also higher than that of China Peking ducks, according to the results of Li et al. (2020).

The difference in body weight between Sikumbang Jonti ducks and other ducks is caused by genetic differences and their habitat environment during maintenance. This follows the statement of Dewi et al. (2017), which states that differences in body weight are caused by genetic and environmental heredity. This is also supported by the statement of Arlina et al. (2024), which states that the characteristics shown by an individual or livestock result from the representation of its genetics.

The age of first egg laying of Sikumbang Jonti ducks (170.19 days) is faster than other local ducks, such as Moluccan ducks, which have an average age of first egg laying of 189 days (Matitaputty & Bansi, 2018), Alabio ducks, which have an average age of first egg laying of 178 days (Susanti & Kumalawati, 2019), and Mojosari ducks which have an average age of first egg laying of 197.12 days (Susanti & Kumalawati, 2019). Based on this, Sikumbang Jonti ducks have an advantage over other local ducks in the form of a faster first egg-laying age.

However, the age at first egg laying of Sikumbang Jonti ducks is not faster than the average age at first egg laying of local China ducks, such as Domyati ducks, Khaki-Campbell ducks, and Shan-ma ducks, which have an age at first egg laying of 109.5 days (El-Deghadi et al., 2022; Lin et al., 2016). On the other hand, the first egg-laying age of Sikumbang Jonti ducks is earlier than that of the White Muscovy duck from China, which lays its first egg at 195 days (Bello et al., 2022).

The average egg production of Sikumbang Jonti ducks (36.62 eggs) is lower than the egg production of other local Indonesian ducks, such as Mojosari ducks, which have an average egg production of 79.8 eggs (Deviyanti et al., 2023) and Alabio ducks with an average egg production of 91.66 eggs (Susanti & Kumalawati, 2019).

In addition, Sikumbang Jonti ducks also have lower egg production when compared to local Chinese ducks, such as Domyati ducks, which have an average egg production of 93.71 eggs, Khaki-Campbell ducks, which have an average egg production of 100.61 eggs (El-Deghadi et al., 2022), Shan-ma ducks which have an average egg production of 65.6 eggs (Lin et al., 2016), and White Muscovy ducks which have an average egg production of 77.78 eggs (Bello et al., 2022).

The low egg production of Sikumbang Jonti ducks in this study was caused by the duck-rearing system, which is different from the standard duck-rearing system in smallholder farms in Payakumbuh City. In this study, Sikumbang Jonti ducks were reared in individual cages, where Sikumbang Jonti ducks naturally live in spacious cages. This follows Malik and Gunawan's (2008) statement that duck egg production tends to be low in intensive rearing systems (caged) because ducks are accustomed to extensive rearing systems (released) and thus experience stress. Therefore, the egg production of Sikumbang Jonti ducks in this study became very low.

The average egg weight of Sikumbang Jonti ducks is heavier when compared to the average egg weight of other local ducks, such as Mojosari ducks, which is 59.17g (Aminuddin et al., 2019), and Maluku ducks, which is 42.00g (Matitaputty & Bansi, 2018), but lighter when compared to the average egg weight of Alabio ducks, which is 72.17g (Sa'diyah et al., 2016), and Lombok ducks (Sasak ducks), which is 61.42g (Maskur et al., 2018).

In addition, Sikumbang Jonti ducks also have lighter egg weights when compared to local ducks from China, Domyati ducks, which have an average egg weight of 61.40g, Khaki-Campbell ducks, which have an average egg weight of 64.00g (El-Deghadi et al., 2022), Jinding ducks, which have an average egg weight of 71.39g (Xin et al. 2024), and Shan-ma ducks, which have an average egg weight of 65.59g and 65.00g (Sun et al., 2024; Lin et al., 2016). Matitaputty and Bansi (2018) state that the duck's environment, genetics, egg composition, and body weight influence differences in egg weight.

The results showed that the coefficient of variation of body weight, age at first egg laying, and egg weight of Sikumbang ducks was moderate diversity, and egg production of Sikumbang Jonti ducks was high diversity. The division of this category is based on the statement of Kurnianto (2010), which states that the diversity category can be divided into three, namely low ($KK \leq 5\%$), medium ($5\% < KK < 15\%$), and high ($KK \geq 15\%$). The results of this study follow the results of research by El-Deghadi et al. (2022), which stated that the egg weight of Domyati (10.7%) and Khaki-Campbell (5.3%)

ducks had moderate diversity, and the egg production of Domyati (24.2%) and Khaki-Campbell (18.8%) ducks had high diversity. However, in the results of El-Deghadi et al. (2022), Domyati and Khaki-Campbell ducks had low diversity in age at first egg laying (1.7%) and body weight (1.0%). On the other hand, the results of Lin et al. (2016) showed that Shan-ma ducks had body weight (8.7%), egg production (10.4%), and egg weight (6.0%) in the medium category, and age at first egg laying (1.7%) in the low category. Based on this, the selection of Sikumbang Jonti ducks is very effective for egg production variables because it is in the high diversity category.

The results of the correlation analysis showed that the body weight of Sikumbang Jontu ducks was not correlated with age at first laying, egg production, and egg weight. This study's results differ from the results of Raziq et al. (2024), which stated that body weight correlates with age at first egg laying, egg production, and egg weight. In addition, Dewi et al. (2017) also noted that duck body weight is positively correlated with egg weight.

Furthermore, age at first egg laying is negatively correlated with low age at first egg laying. This is consistent with the research of Raziq et al. (2024), which states that a longer age at first laying can increase egg production during the production period.

Finally, egg production of Sikumbang Jonti ducks had a moderate positive correlation with egg weight. This differs from the opinion of Raziq et al. (2024) and Ekinci et al. (2023), which stated that egg production negatively correlates to egg weight. According to Matitaputty and Bansi (2018), this occurs due to the addition of egg weight in line with the increasing age of ducks, so that egg weight continues to increase along with the increase in egg production.

Based on the diversity and correlation of egg production performance of Sikumbang Jonti ducks, the advantage of Sikumbang Jonti ducks with a faster age of first laying eggs is a limiting factor for duck egg production, which is also correlated to egg weight. The selection variable can be a good predictor of egg production performance. Egg weight is the first age because the longer the first age of laying Sikumbang Jonti ducks, the higher the production and egg weight of duck eggs. This is following the opinion of Ekinci et al. (2023), Muir et al. (2022), and Anene et al. (2021), who reported that laying hens with lower body weights have a later age of first egg laying but more egg production.

CONCLUSION

From the results of this study, it can be concluded that a longer first egg-laying age can be used as a selection variable to increase the production and egg weight of Sikumbang Jonti ducks.

REFERENCES

Abigaba, R., P.C. Sianangama, E.S. Mwaanga, W.N.M. Mwenya, and P.H. Nyanga. 2024. Correlation between morphometric and motility characteristics of spermatozoa in semen of Lusitu Boars. IJVS 13(6):941-947. DOI: https://doi.org/10.47278/journal.ijvs/2024.191

Aminuddin, B., L.D. Mahfudz, and R. Muryani. 2019. Effect of soy sauce dregs use in rations on the exterior quality of Mojosari duck eggs. Jurnal Sain Peternakan Indonesia 14(1):113–18. DOI: https://doi.org/10.31186/jspi.id.14.1.113-118

Anene, D.O., Y. Akter, P.C. Thomson, P. Groves, S. Liu, and C.J. O'Shea. 2021. Hens that exhibit poorer feed efficiency produce eggs with lower albumen quality and are prone to being overweight. Animals 11:2986. DOI: https://doi.org/10.3390/ani11102986

Arlina, F., R. Rusfidra, Y. Safitri, and T. Rafian. 2024. Efforts for selection of the lenggek crowing number of Kokok Balenggek chicken based on qualitative phenotypic characteristics. AIP Conference Proceedings 3001(1). DOI: https://doi.org/10.1063/5.0185980

Arlina F, H. Husmaini, R. Rhoudha, W.R. Sardi, and T. Rafian. 2021. Qualitative and quantitative phenotypic diversity of Sikumbang Jonti ducks as germplasm in West Sumatra. Journal Trop. Anim. Vet. Sci. 11:291–299. DOI: https://doi.org/10.46549/jipvet.v11i3.173

Deviyanti, W., F. Irawan, P. Budiarti, and R. Putri. 2023. Palas farm (cultivation of laying ducks with intensive system on Mojosari duck breed). Communnity Development

Journal DOI: 4(6):12106–12110. https://doi.org/10.31004/cdj.v4i6.21991

Dewi, E.P., E. Suprijatna, and E. Kurnianto. 2017. Effect of first generation parent body weight on fertility, hatchability, and hatching weight in Magelang ducks at Banyubiru-Ambarawa duck working unit. Jurnal Sain Peternakan Indonesia 12(1):1–8. DOI: https://doi.org/10.31186/jspi.id.12.1.1-8

Ekinci, O., N. Esenbuga, and V. Dagdemir. 2023. The effects of body weight and age on performance, egg quality, blood parameters, and economic production of laying hens. Journal of the Hellenic Veterinary Medical Society 74(2):5799–5806. DOI: https://doi.org/10.12681/jhvms.30324

El-Deghadi, A.S., W.A.H. Ali, and M.G. Gharib. 2022. Study for Some Body Weight and Egg Traits in Domyati and Khaki-Campbell Ducks. Open Journal of Agricultural Research 2(1):29–36. DOI: https://doi.org/10.31586/ojar.2022.260.

Husmaini, H., L. Suhartati, and Y.Heryandi. 2024. Short communication: diversity of quantitative characteristics of Sikumbang Jonti ducks and Peking ducks. International Journal of Agriculture and Biosciences 2024 13(3):397-401. DOI: https://doi.org/10.47278/journal.ijab/2024.133

Kurnianto, E. 2010. Ilmu Pemuliaan Ternak. Semarang: Universitas Diponegoro.

Li, G.S., F. Zhu, F.X. Yang, J.P. Huo, and Z.C. Hou. 2020. Selection response and genetic parameter estimation of feeding behavior traits in Pekin ducks. Poultry Science 99:2375-2354. DOI: https://doi.org/10.1016/j.psj.2020.01.013

Malik, A., and A. Gunawan. 2008. Effects of injecting low doses of gonadotropin hormone on the number and size of Alabio duck eggs. Jurnal Ilmu Ternak 8(1):91–94. DOI: https://doi.org/10.24198/jit.v8i1.2221

Maskur, M., S. Prasetyo, R. Jan, T. Rozi, and L.M. Kasip, 2018. Egg production and quality of local Lombok ducks for salted eggs intensively raised by farmers in central Lombok. Jurnal Ilmu dan Teknologi Peternakan Indonesia 4(1):199–206. DOI: https://doi.org/10.29303/jitpi.v3i1.31

Masti, H., Y. Yurnalis, T.D. Nova, Z. Kamsa, and T. Rafian. 2021. Polymorphism of growth hormone receptor (GHR) gene exon 10 in Sikumbang Jonti ducks. Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan 9(1):15-19. DOI: https://doi.org/10.29244/jipthp.9.1.15-19

Matitaputty, P.R., and H. Bansi. 2018. Efforts to increase the productivity of laying ducks intensively and feeding local ingredients in Maluku. Jurnal Peternakan Sriwijaya 7(2):1–8. DOI: https://doi.org/10.33230/JPS.7.2.2018.7467

Muir, W.I., Y. Akter, K. Bruerton, and P.J. Groves. 2022. The influence of hen size and diet nutrient density in early lay on hen performance, egg quality and hen healty in late lay. Poultry Science 101:102041. DOI: https://doi.org/10.1016/j.psj.2022.102041

Noor, R.R. 2008. Animal Genetics. Jakarta: Penebar Swadaya.

Xin, Q. L., Li, B., Zhao, W. Shi, X. Hao, L. Zhang, Z. Miao, Z. Zhu, Q. Huang, and N. Zheng. 2024. The network regulation mechanism of the effects of heat stress on the production performance and egg quality of Jinding duck was analyzed by miRNA–mRNA. Poultry Science 103(1):103255. DOI: https://doi.org/10.1016/j.psj.2023.103255

Lin, R.L., H.P. Chen, R. Rouvier, and C. Marie-Etancelin. 2016. Genetic parameters of body weight, egg production, and shell quality traits in the Shan Ma laying duck (Anas platyrhynchos). Poultry Science 95(1):2514-2519. DOI: https://doi.org/10.3382/ps/pew222

Rajkumar, U., M. Niranjan, L.L.L. Prince, C. Paswan, S. Haunshi, and B.L.N. Reddy. 2020. Genetic evaluation of growth and production performance and short term selection response for egg mass in Gramapriya female line. Indian Journal of Animal Sciences, 90(3):401–406. DOI: https://doi.org/10.56093/ijans.v90i3.102520

Rajkumar, U., L.L.L. Prince, K.S. Rajaravindra, S. Haunshi, M. Niranjan, and R.N.

Chatterjee. 2021. Analysis of (co) variance components and estimation of breeding value of growth and production traits in Dahlem Red chicken using pedigree relationship in an animal model. PLoS ONE 16(3):e0247779. DOI: https://doi.org/10.1371/journal.pone.0247779

Raziq, F., J. Hussain, S. Ahmad, M.A. Hussain, M.T. Khan, A. Ullah, M. Qumar, F. Wadood, and G.E. Faran. 2024. Effect of body weight at photostimulation on productive performance and welfare aspects of commercial layers. Anim Biosci 37(3):500-508. DOI: https://doi.org/10.5713/ab.22.0365

Sa'diyah, H., A. Anggraeni, and D. Sudrajat. 2016. Production performance of Alabio ducks (Anas plathyrynchos Borneo) fed commercial rations with added organic chromium (Cr). Jurnal Peternakan Nusantara 2(2):55–60. DOI: https://doi.org/10.30997/jpnu.v2i2.387

Saginbayeva, M., G. Temirbekova, R. Sharipov, A. Shamshidin, D. Senkebayeva, and B. Aryn. 2024. Assessment of growth and development of hybrid duckling offspring. BIO Web of Conferences 85: 01038. DOI: https://doi.org/10.1051/bioconf/20248501038

Bello, S.F., H. Xu, K. Li, L. Guo, S. Zhang, R.O. Ahmed, E.J. Bekele, M. Zheng, M. Xian, B.A. Abdalla, A.C. Adeola, A.A. Adetula, R.A. Lawal, W. Zhu, D. Zhang, X. Zhang, C. Ji, and Q. Nie. 2022. Research note: association of single nucleotide polymorphism of AKT3 with egg production traits in White Muscovy ducks (Cairina moschata). Poultry Science 101(12):102211. DOI: https://doi.org/10.1016/j.psj.2022.102211

Subekti, K., D.D. Solihin, R. Afnan, A. Gunawan, and C. Sumantri. 2019. Polymorphism of duck HSP70 gene and MRNA expression under heat stress conditions. International Journal of Poultry Science 18(12):591–97. DOI: https://doi.org/10.3923/ijps.2019.591.597

Susanti, T., and D.S. Kumalawati. 2019. Genetic trait improvement through selection to increase egg production of Alabio and Mojosari ducks. Pros. Semnas. TPV-2019, 552–559. DOI: https://doi.org/10.14334/pros.semnas.tpv-2019-p.552-559

Sun, Y., Y. Li, X. Jiang, Q. Wu, R. Lin, H. Chen, M. Zhang, T. Zeng, Y. Tian, E. Xu, Y. Zhang, and L. Lu. 2024. Genome-wide association study identified candidate genes for egg production traits in the Longyan Shan-ma duck. Poultry Science 103(9):104032. DOI: https://doi.org/10.1016/j.psj.2024.104032

Yurnalis, Y., A. Arnim, D.E. Putra, Z. Kamsa, and T. Afriani. 2019. Identification of GH gene polymorphisms and their association with body weight in Bayang duck, local duck from West Sumatra, Indonesia. IOP Conference Series: Earth and Environmental Science 347. Institute of Physics Publishing. DOI: https://doi.org/10.1088/1755-1315/347/1/012032

Yurnalis, Y., H. Husmaini, and S. Sabrina. 2017. Polymorphisms of growth hormone gene exon 1 and their associations with body weight in Pitalah and Kumbang Janti Ducks. Int. J. Poult. Sci. 16(5):203–208. DOI: doi: 10.3923/ijps.2017.203.208

Zhang, Y., C. Jia, S. Li, S. Wang, Z. He, G. Wu, M. Yu, Y. Lu, and D. Yu. 2024. Comparative genome-wide association study on body weight in Chinese native ducks using four models. Poultry Science 103:103899. DOI: https://doi.org/10.1016/j.psj.2024.103899

Zhu, T., X. Qi, Y. Chen, W. Liang, L. Xueze, Y. Weifang, Z. Jianwei, L. Kaiyang, N. Zhonghua, J. Zhihua, and Q. Lujiang. 2021. Positive selection of skeleton-related genes during duck domestication revealed by whole genome sequencing. BMC Ecology and Evaluation 21 (165). DOI: https://doi.org/10.1186/s12862-021-01894-7