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The Effect of Egg Weight on Fertility, Hatchability, and Hatching Weight in Ducks: A Quantitative Observational Study

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Abstract: Egg weight is one of the physical characteristics often associated with reproductive performance in ducks, particularly fertility, hatchability, and hatching weight. This study aimed to evaluate the effect of egg weight on fertility, hatchability, and Day Old Duck (DOD) weight. A quantitative approach with an analytical observational design was applied to 100 duck eggs incubated under standard temperature and humidity conditions using an incubator. Parameters observed included egg weight, fertility (candling), hatchability, and DOD weight, which were analyzed using simple linear regression. The results showed that egg weight did not significantly affect fertility or hatchability. However, egg weight had a significant effect on DOD weight, indicating that heavier eggs provide greater nutrient reserves for embryonic development. In conclusion, egg weight is not a primary determinant of fertility and hatchability but plays an important role in determining the hatching weight of ducklings.

Keywords: *Egg Weight; Fertility; Hatchability; Day Old Duck.*

Introduction

The poultry farming sector has a strategic role in supporting national food security, especially in providing affordable and quality animal protein sources. One of the poultry commodities that has great potential to be developed is ducks, this is due to its high adaptability to various environmental conditions and its relatively stable productivity. In addition to being an egg producer, ducks also have economic value in seed production through hatching activities, so the reproductive aspect is an important factor that needs to be considered to determine the productivity and efficiency of the livestock business. The use of hatching machines in terms of reproduction in duck farms is to obtain seeds with high and quality hatchability.

Fertility and hatchability are key indicators of hatchery performance and are influenced by broodstock quality and incubation management. Several factors such as temperature, humidity, and egg turning frequency during incubation, as well as broodstock characteristics including nutrition, health, age, and egg quality, have been widely reported to affect hatching success (Lestariningsing et al., 2023). However, the role of egg weight as a physical characteristic in determining fertility, hatchability, and hatching weight in ducks remains inconsistent and has not been clearly established. Therefore, further investigation is needed to clarify the extent to which egg weight contributes to variations in reproductive performance.

In addition, the factor that affects these reproductive parameters is the weight of the egg. Free-range chicken eggs with too much weight reduce hatching success (Aldiyanti, et al., 2025). Biologically, egg weight is related to the nutritional content available to the embryo during the incubation process. Eggs with a larger weight generally have higher nutrient reserves, so they have the potential to produce embryos that develop more optimally. However, the effect of egg weight on fertility, hatchability, and DOD weight does not always show consistent results, as it is influenced by various other factors such as broodstock quality, mating management, and incubation conditions.

Some previous studies have reported that egg weight has a close relationship with hatch weight (DOD), but it does not always have a significant effect on fertility and hatchability. This

suggests that factors other than egg weight, such as male sperm quality, parental age, incubation temperature and humidity, and egg storage duration, play a more dominant role in determining fertilization and hatching success (Suciati et al., 2023). However, most of these studies have been conducted on chickens, while studies focusing specifically on local Indonesian ducks are still limited.

A number of previous studies have examined the effect of egg weight on hatching performance in poultry, but the results obtained still show variations depending on the type of duck, brood health, brood age, body weight, broodstock shape, rearing conditions, and hatching techniques used (Lestariningsih et al., 2023; Aldiyanti et al., 2025). Therefore, further research is needed to obtain more specific and contextual information, especially on the condition of local livestock in Indonesia. Based on this description, this study is important to analyze more deeply the influence of egg weight on fertility, hatchability, and weight of Day Old Duck (DOD) in ducks. The results of this study are expected to provide useful scientific information in improving production efficiency and hatching success in the duck farming business, as well as supporting community nutrition fulfillment programs in a sustainable manner.

Materials and Methods

This study employed a quantitative approach with a non-experimental (observational analytic) design to analyze the effect of egg weight on fertility, hatchability, and Day Old Duck (DOD) weight in ducks. The statistical hypotheses were defined as follows: H0: egg weight has no significant effect on fertility, hatchability, and DOD weight; and Ha: egg weight has a significant effect on fertility, hatchability, and DOD weight. A total of 100 duck eggs were used as observation units, obtained from a single local duck farm with laying ducks in normal physical condition and relatively uniform age. The selected eggs met the criteria of having a normal (oval) shape, clean shells, no cracks, and uniform shell color according to the breed characteristics.

Egg weight was measured using a digital scale with an accuracy of 0.01 g and was treated as the independent variable in the analysis. All eggs were incubated in a hatching machine at a constant temperature of 37.5°C and relative humidity of 70% throughout the incubation period. Fertility was determined using the candling method on the 5th day of incubation. Hatchability was calculated as the percentage of fertile eggs that successfully hatched. The hatching process was completed on the 28th day of incubation, which corresponds to the normal incubation period of ducks. Hatched ducklings were weighed after their feathers had dried (±24 hours) to obtain DOD weight.

The observed parameters included fertility (%), hatchability (%), and DOD weight (g). The data were analyzed using simple linear regression to evaluate the effect of egg weight on each observed parameter.Which are calculated based on the standard formula for poultry hatching, which is as follows:

Fertility Formula :

$$Fertility : \frac{Number\ of\ Fertile\ Eggs}{Total\ Eggs\ Set}\ x\ 100\%$$

Hatchability Formula :

$$Hatchability : \frac{Total\ Chicks\ Hatched}{Number\ of\ Fertile\ Eggs}\ x\ 100\%$$

The data obtained were analyzed using simple linear regression with the help of statistical software (SPSS). The equation model used is:

$$Y = \alpha + bX$$

Description :
Y = fertility, hatchability, and weight of DOD
X = egg weight

a = constant
b = regression coefficient
to determine the relationship between egg weight and response variables, and its significance was tested using a t-test at a confidence level of 95% ($\alpha = 0.05$) and a determination coefficient (R^2).

Results and Discussion

Before performing regression analysis, descriptive statistics were conducted to provide an overview of the research data. The results showed that the average egg weight was 60.83 ± 8.52 g, ranging from 44.00 to 78.00 g. The fertility rate was 58%, indicating that 58 out of 100 eggs were fertilized. Hatchability was calculated based on fertile eggs, resulting in a value of 91.38%, while hatchability based on total eggs was 53%. This indicates that although not all eggs were fertilized, most of the fertile eggs were able to hatch successfully. The average Day Old Duck (DOD) weight was calculated only from hatched ducklings (n = 53), resulting in a mean value of 43.13 ± 6.80 g, with a range of 30 to 53 g. This indicates a relatively normal distribution of hatch weights and reflects the growth performance of embryos during incubation. These descriptive results provide a general overview of the data and serve as the basis for further regression analysis.

Egg Weight Against Fertility

Based on research that has been carried out, the effect of duck egg weight on fertility can be seen in Table 1.

Table 1. The Effect of Duck Egg Weight on Fertility

Variable	Regression Coefficient (b)	t	sig	R Square
Fertility	0,004	0,684	0,495	0,005

Source : Primary Data (2026).

Based on the results of research that has been carried out on the effect of duck egg weight is an unreal effect (P>0.05) on fertility. This can be seen from the t-value of 0.684 with a significance value (Sig) of 0.495 which is greater than 0.05, indicating that variations in egg weight, both large and small, do not directly guarantee whether the egg will be fertilized (fertilized) or not. This is in line with Syamsiningsih, et al., (2023) that the weight of duck eggs has no real effect on fertility, and is reinforced by Aldiyanti, et.al., (2025), that the weight of 40-50 grams of free-range chicken eggs has an unreal effect on fertility, while the weight of free-range chicken eggs of 50-60 grams has a negative effect on fertility.

Low value of the determination coefficient (R^2 =0.005) suggests that egg weight variation is only able to explain 0.5% of fertility variations, while the other 99.5% is determined by external and biological factors. Biologically, fertility is highly dependent on the quality of gametes from the mother, especially the quality of sperm from the male as well as the health of the reproductive system of the female mother. According to Syamsiningsih, et al., (2023), fertility rates and germination are comprehensively influenced by the interaction of biological factors such as sperm quality, hormonal status, and maternal age, and are supported by management and environmental variables that include *Sex Ratio*, mating time interval, feed nutrient quality, system *Breeding*, and the influence of seasonal fluctuations.

Physiologically, fertility is determined by the successful penetration of sperm into the germinal disc on the vitelin membrane. This process occurs in the infundibulum shortly after ovulation, long before the egg's shell is fully formed and determines the final weight of the egg. Therefore, the volume of albumen or the small size of the shells (which make up the weight of the egg) has no mechanistic correlation with the probability of successful fertilization.

Egg weight to hatchability

Based on the research that has been carried out, the effect of the weight of duck eggs on hatchability can be seen in Table 2.

Table 2. The Effect of Duck Egg Weight on Hatchability

Variable	Regression Coefficient (b)	t	sig	R Square
Hatchability	0,006	1,012	0,314	0,010

Source : Primary Data (2026).

The results showed that the weight of Peking duck eggs had an intangible effect on hatchability (P>0.05). This is because the weight of the eggs used is still in the normal range with an average egg weight of 60 grams. In accordance with Sutanta et al., (2019), that good eggs for hatching are eggs with a normal weight, which is in the range of 54-75 grams. Egg weight that is too heavy (>77 grams) or too small (<50 grams) can lead to a decrease in hatching. This is reinforced by Aldiyanti, et.al., (2025), that the weight of chicken eggs that is too large has a negative effect on hatching. This shows that hatchability is more influenced by other factors such as incubation conditions, temperature and humidity of the hatching machine, embryo quality, and the length of egg storage before hatching. This is in line with Yuniarinda, et al., (2019) that the weight of duck eggs has no real effect on the presentation of hatchability.

Biologically, hatching success is largely determined by the quality of the embryo related to the condition of the parent, such as age and nutritional status. According to Yuniarinda, et al., (2019) that hatchability is more influenced by the parent age factor than the weight of the egg, where the increase in the age of the mother causes a decrease in the physiological function of the reproductive organs which has an impact on decreasing egg quality, thereby inhibiting embryo development and implicating a low percentage of hatchability. In addition, external factors such as temperature, humidity, and egg storage time have a greater influence on hatchability. Research by Ashary et.al., (2025), shows that temperature affects the hatching of duck eggs. Temperatures that are too low (35–36°C) slow down embryo development, thereby lowering fertility and reducing hatchability. Meanwhile, too high a temperature (39–40°C) adversely affects embryo development because it increases heat stress, decreases hatch weight and causes the death of the embryo in the shell.

The very low R Square value (1%) in this study reinforces that egg weight is not the dominant factor in determining hatchability. Nevertheless, the weight of the egg still plays a role in providing nutrients for embryonic development. Eggs with larger weights tend to have more nutrient reserves, but without optimal incubation conditions, they do not provide a significant increase in hatchability.

Egg Weight Against Hatch Weight (DOD)

Based on the research that has been carried out, the effect of duck egg weight on hatch weight (DOD) can be seen in Table 3.

Table 3. Effect of Duck Egg Weight on Hatch Weight (DOD)

Variable	Regression Coefficient (b)	t	sig	R Square
Hatch Weight	0,640	2,509	0,014	0,060

Source : Primary Data (2026).

The results of the study show that Egg weight has a real effect on the weight of the Day Old Duck (DOD) hatch. A t-value of 2.509 with a significance value of 0.014 (P<0.05) indicates that the weight of the egg has a significant effect on the weight of the DOD produced. This means that the

greater the weight of the egg, the higher the DOD weight tends to result. This is in accordance with Darmike, et.al (2025), stating that egg weight has a positive relationship with hatch weight, where the greater the egg weight, the greater the hatch weight produced. This suggests that egg weight is one of the important factors that determine hatch weight, as it is directly related to the amount of nutrient reserves available to the embryo during development, although it is still influenced by other factors such as incubation conditions and egg quality.

Meanwhile, in the Day Old Duck (DOD) weight variable, an R Square value of 0.060 was obtained, which means that the egg weight was able to explain 6% of the variation in DOD weight, while the remaining 94% was influenced by other factors such as genetic factors, egg nutritional quality, and embryo development conditions during the incubation process. This is in accordance with research conducted by Syamsiningsih, et.al., (2023), stating that optimal incubation conditions are able to produce higher hatch weights, where at a temperature of 37–38°C the best average hatch weight is obtained compared to temperatures that are too low or too high. This shows that in addition to the egg weight factor, the success of hatching weight formation is also influenced by the optimal utilization of embryo nutrients during the incubation process, so that eggs with larger nutrient reserves will produce higher hatch weight if supported by appropriate incubation conditions. Although the contribution of egg weight to DOD weight is relatively low, the results of previous significance tests show a noticeable influence, so egg weight still has a role in determining the weight of ducklings produced, although not as a dominant factor.

Conclusion

Based on the results of the study, it can be concluded that egg weight does not have a significant effect on fertility and hatchability, but it has a significant effect on the hatching weight of Day Old Duck (DOD). Larger egg weights tend to result in higher hatch weights. Therefore, farmers should prioritize breeder quality and proper incubation management rather than selecting eggs solely based on their weight.

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