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Effect of Duck Breed on Reproductive Performance of Parent Stock, Quality of Day-Old Ducks (DOD) in Alabio, Mojosari, and Their Crossbreeds

Putri Fajriah[1], Sucik Maylinda[2], Adelina Ari Hamiyanti[3]
[1,2,3] Department of Animal Science, Faculty of Animal Science, Universitas Brawijaya Malang, East Java, 65145, Indonesia

ABSTRACT: This study aims to evaluate the reproductive performance of duck breeders and assess the quality of day-old ducks (DOD) in Alabio, Mojosari, and their crossbred lines. The experimental design employed involved three breed groups: MM (Mojosari ♂ × Mojosari ♀), AA (Alabio ♂ × Alabio ♀), and AM (Alabio ♂ × Mojosari ♀), each consisting of 30 female ducks and 6 male ducks. Egg collection was conducted over a 5-day period to obtain 100 eggs from each breed group. Breed differences had a highly significant effect on the egg shape index, with the highest recorded in the AM group (79.80%). However, there were no significant differences in egg weight (63.90–65.13 g) or fertility rate (72–81%). The AM ducks also exhibited the highest hatchability (75.95%) and the lowest embryonic mortality (24.46%). Hatch weight and post-hatch viability score were not significantly affected by breed differences; the highest hatch weight was observed in the AA group (38.58 ± 1.07 g), with post-hatch viability scores ranging from 9.74 to 9.84. However, DOD body length differed significantly, with the MM group displaying the longest body length (18.88 ± 0.30 cm). Based on the results, it can be concluded that the crossbreeding of Alabio male ducks with Mojosari female ducks (AM) demonstrates superior reproductive performance in terms of egg shape index, hatchability, and embryonic mortality, although certain parameters such as egg weight, fertility, hatch weight, and post-hatch viability score did not show significant differences among the breed groups.

KEYWORDS: Alabio Duck, Crossbreeding, Mojosari Duck, Performance, Reproduction

INTRODUCTION

Reproductive performance in poultry, particularly ducks, is a crucial factor in breeding and egg production efforts. The quality of day-old ducklings (DOD) is significantly influenced by various factors, one of which is the difference in the breed or species of ducks used in the breeding process. Each breed or species of duck has distinct genetic characteristics, which affect reproductive performance, egg quality, and hatchability. The genetic makeup of different duck breeds contributes to differences in egg-laying rates, hatching success, and survival rates of offspring. Therefore, selecting the appropriate breed is essential to obtaining superior offspring that can provide optimal results in the long term. In poultry breeding, the ability of the mother to successfully reproduce is a key determinant of the productivity and efficiency of the farm. As emphasized by Sadjadi et al. (2019), genetic variation plays a pivotal role in influencing the reproductive traits in poultry, such as fertility, hatchability, and offspring quality. The choice of breed is not only based on these factors but also on the adaptability of the breed to local environmental conditions, which further enhances the farm's long-term sustainability (Sadjadi et al., 2019).

Alabio ducks and Mojosari ducks are two well-known duck breeds in Indonesia, each with its advantages in egg and meat production. Alabio ducks are known for their good hatchability and high body endurance, while Mojosari ducks excel in egg production. Alabio ducks have demonstrated a consistent ability to produce strong offspring with good growth rates, making them a favorable choice for egg and meat production. On the other hand, Mojosari ducks, with their high egg-laying performance, are often chosen for commercial egg production. The development of a crossbreed between these two duck breeds is expected to produce offspring that combine the strengths of both breeds. Research by Alimuddin et al. (2020) suggests that crossbreeding can lead to hybrid vigor (heterosis), which enhances the performance of offspring in traits such as growth rate, reproductive efficiency, and resistance to diseases. The combination of the superior qualities of Alabio and Mojosari ducks through crossbreeding could potentially lead to a new breed that is well-suited for both meat and egg production. Moreover, the resultant offspring might exhibit better overall productivity and resilience.

Research on the differences between breeds in terms of reproductive performance of the parents and the quality of day-old ducklings (DOD) is necessary to gain a clear understanding of the potential possessed by Alabio ducks, Mojosari ducks, and their

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offspring (crossbreeds). Such research will enable breeders to make informed decisions when selecting breeds that are most suited to specific farming goals, whether for egg or meat production. Furthermore, understanding the genetic influences on the performance of DOD allows breeders to optimize management practices to enhance the survival and growth of young ducklings. As observed by Anwar et al. (2018), different breeds exhibit varying reproductive capabilities that directly impact the quality of DOD. For instance, in their study, they found that ducks from certain breeds had higher hatchability rates, producing healthier and stronger day-old ducklings. This finding supports the notion that breed selection significantly influences the initial performance of ducklings, which is a critical aspect of successful poultry farming.

Additionally, a study by Alimuddin et al. (2020) mentioned that crossbreeding two superior breeds often results in offspring with enhanced characteristics, including better growth and hatchability. In their research, they noted that hybrid offspring often exhibited improved feed conversion ratios and faster growth rates compared to purebred ducks. The crossbreeding of Alabio and Mojosari ducks may similarly result in offspring that combine the best traits of both breeds, making them more efficient for both egg and meat production. Therefore, this study aims to analyze the differences in reproductive performance of the parents and DOD quality in Alabio ducks, Mojosari ducks, and their offspring to provide useful recommendations for farmers in choosing the type of duck to breed. This approach would ultimately support the improvement of farm productivity and sustainability.

MATERIALS AND METHOD

The experimental materials consisted of three groups of local duck breeds, namely MM (Mojosari ♂ × Mojosari ♀), AA (Alabio ♂ × Alabio ♀), and AM (Alabio ♂ × Mojosari ♀), each comprising 30 females and 6 males, resulting in a total of 108 ducks. The average age of the ducks at the time of the study was 48 weeks. The equipment used in this study included an incubator, setter trays, hatching trays, a candling device for embryo observation, a digital scale to measure egg and Day Old Duck (DOD) weight, and a caliper to measure the length and width of the eggs. This research was conducted using an experimental method with a Completely Randomized Design (CRD) consisting of three breed groups (MM, AA, and AM). The research stages included location surveys, selection of parent ducks and hatching eggs, and an incubation period of 28 days. Sample selection was performed purposively based on phenotypic and physiological criteria, such as feather color, health status, and uniform body weight (1.5–1.6 kg). Hatching eggs were collected over five days, with weights ranging from 65 to 75 grams, and were selected based on clean and uncracked shells. The eggs were incubated at a temperature of 37.5– 38.5°C and a relative humidity of 60–70%. The incubation lasted for 28 days, during which the eggs were placed in setter trays until day 25, after which they were moved to hatcher trays until hatching. After hatching, DOD observations and measurements were made on the quality of the day-old ducks. The collected data included reproductive performance parameters such as egg weight, egg shape index, fertility rate, hatchability of fertile eggs, and embryo mortality. The quality of DOD was evaluated based on hatch weight, body length, and Pasgar score. Data were analyzed using one-way analysis of variance (ANOVA) at a significance level of 5% and 1%. When significant differences were detected, they were followed by the Least Significant Difference (LSD) test.:

RESULT AND DISCUSSION

Reproduction Performance.

Reproductive performance is a measure or indicator that reflects the ability of breeding animals to carry out their reproductive functions optimally. In the context of animal husbandry, reproductive performance encompasses several important aspects such as fertility, which is the ability to produce viable eggs or sperm, and hatchability, indicating the percentage of eggs that successfully hatch into healthy and live offspring. Additionally, reproductive performance includes egg-laying frequency, egg quality, reproductive lifespan of the breeder, and the interval between reproductive cycles. All these parameters serve as benchmarks for the success of breeders in producing quality offspring that can support the sustainability of livestock farming. Reproductive performance not only reflects genetic factors but is also influenced by management practices, nutrition, and environmental conditions that collectively support the overall reproductive process. The average values and standard deviations of the reproductive performance of Alabio (AA), Mojosari (MM), and Alabio x Mojosari (AM) cross ducks are presented in Table 1.

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Table 1. Average Reproductive Performance of Duck Genotypes AA, MM, and AM

Breed	Alabio X Alabio	Mojosari X Mojosari	Alabio X Mojosari
Egg Shape Index (mm)	77,35 ± 1,69	78,31 ± 0,81	79,80 ± 1,24
Egg Weight (gr)	64,31 ± 1,20	65,13 ± 4,64	63,90 ± 2,37
Fertility (%)	81,00 ± 23,48	80,00 ± 9,43	72,00 ± 12,29
Hatchability (%)	64,58 ± 10,09	71,36 ± 11,06	75,95 ± 6,93
Embrionic Mortality (%)	35,43 ± 10,09	28,65 ± 11,06	24,46 ± 8,13

Egg Shape Index

The egg shape index is a crucial metric in evaluating the quality of eggs, particularly regarding their potential for successful hatching. The symmetry of an egg is vital because more symmetrical eggs are believed to offer more consistent heat distribution during incubation, promoting uniform embryo development (Baruah et al., 2021). This characteristic not only affects the physical appearance of the egg but also plays a key role in ensuring proper embryo growth. For instance, a more oval-shaped egg typically facilitates better heat conduction, which helps maintain a consistent internal temperature throughout the incubation process. As a result, eggs with higher symmetry often exhibit improved hatchability, which is critical for maximizing productivity in poultry operations. In the context of the Alabio X Alabio breed, with an egg shape index of 77.35 ± 1.69 mm, the breed demonstrates a well-balanced egg form that is likely conducive to successful incubation outcomes. A study by Baruah et al. (2021) also highlighted that symmetrical eggs tend to have higher hatchability rates, as they are more likely to provide the ideal conditions for embryo development. This suggests that breeders who focus on selecting for eggs with more balanced shapes can potentially enhance reproductive success in their flocks, improving both hatchability and overall egg production.

However, it is essential to recognize the role of genetic variation in influencing egg shape across different poultry breeds.

In this study, Mojosari X Mojosari and Alabio X Mojosari breeds exhibit slight variations in their egg shape indices, with the Mojosari breed showing a higher index (78.31 ± 0.81 mm) compared to the Alabio breed (79.80 ± 1.24 mm). These differences could be attributed to the distinct genetic makeup of the breeds, which influences egg morphology. While genetic traits are integral to the overall reproductive success, the selection for specific traits, such as egg shape, has long been a focus in breeding programs aimed at optimizing hatchability and flock productivity (Baruah et al., 2021). The subtle variations in egg shape observed between these breeds highlight how specific genetic lines can lead to better or worse reproductive outcomes, even in traits like symmetry. These differences may also reflect the ongoing genetic selection practices in poultry breeding programs, which prioritize desirable egg quality characteristics that ultimately influence hatch rates. Additionally, optimizing egg shape through breeding strategies can have downstream effects on the overall productivity and efficiency of the poultry operation, as better hatchability contributes to a higher yield of healthy chicks. Thus, understanding and improving egg shape through careful genetic selection can offer long-term benefits to poultry farming, especially when it comes to optimizing hatching success and ensuring that the flock remains productive over time. This approach aligns with findings from other studies, which suggest that egg shape index optimization is an effective strategy for enhancing reproductive performance in poultry species (Baruah et al., 2021).

Egg Weight

Egg weight is not only an indicator of the nutritional reserves available to the developing embryo but also serves as a key determinant in determining the overall health and survival rate of the offspring. Larger eggs, as mentioned, contain more nutrients, which directly contribute to the robust development of the embryo (Ali et al., 2022). The Mojosari X Mojosari breed's higher egg weight of 65.13 ± 4.64 grams suggests a genetic advantage in terms of producing larger eggs, which can be linked to better early-stage development and chick survival. This could make Mojosari X Mojosari ducks more suitable for breeding programs focused on improving chick vitality and overall farm productivity. However, while larger eggs can be beneficial for embryo growth, they also pose certain challenges during the hatching process. Studies have shown that overly large eggs can sometimes cause hatching difficulties, particularly if the size exceeds the capacity of the hatchery or incubator to properly manage them (Yadav et al., 2020). Large eggs may result in longer incubation times or increased risk of physical malformations during the hatching process. Therefore,

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it is important to strike a balance between egg size and hatchability, ensuring that eggs are neither too large nor too small to hinder successful reproduction.

In contrast, the Alabio X Alabio breed's egg weight of 64.31 ± 1.20 grams, while slightly smaller, still provides the necessary nutrients for optimal embryo development. Smaller eggs often offer advantages in terms of easier handling and more predictable hatching success, as they are less likely to experience complications during the hatching phase. These findings indicate that smaller eggs can also contribute to successful reproduction, provided that other factors such as the genetic quality of the breed, egg care, and incubation conditions are optimized. This suggests that a range of egg sizes can lead to positive outcomes, as long as the breeding and incubation processes are carefully managed to minimize risks associated with both excessively large and small eggs. Therefore, egg weight plays a significant role in reproductive success, but it should be considered alongside other factors such as genetics, nutrition, and environmental conditions. By managing egg weight effectively through selective breeding and proper incubation techniques, poultry breeders can enhance hatchability rates while ensuring the health and survival of their offspring.

Fertility

Fertility is a fundamental factor in poultry breeding, as it directly impacts the production of fertilized eggs, which is essential for maintaining a consistent supply of hatching eggs. High fertility rates are crucial for sustainable egg production, especially in commercial poultry farming. As highlighted by Siti et al. (2019), fertility can be influenced by several variables, including male fertility, the overall health and genetic quality of the female ducks, and environmental factors such as temperature, humidity, and stress levels. The Alabio X Alabio breed, with a fertility rate of 81.00 ± 23.48%, outperforms Alabio X Mojosari, which has a fertility rate of 72.00 ± 12.29%. The significant difference in fertility rates between these two breeds may indicate the genetic superiority or compatibility of the Alabio X Alabio pair, suggesting that genetic selection plays a critical role in improving reproductive success.

In addition to genetic factors, fertility rates are also affected by the quality of care provided to the breeding flock. Environmental management practices such as controlled mating schedules, proper nutrition, and disease prevention are key contributors to maintaining high fertility (Babu et al., 2020). The variability seen in fertility rates between the Mojosari X Mojosari (80.00 ± 9.43%) and other breed combinations further emphasizes that breeding management, including the careful selection of both males and females, is essential for optimizing fertility outcomes. Researchers suggest that improving the health status of the breeding flock and maintaining an optimal environment during the breeding season can significantly enhance fertility rates and contribute to a higher number of fertilized eggs, thereby improving the overall productivity of poultry farms (Babu et al., 2020). Furthermore, fertility rates are not only influenced by genetics but also by the regular monitoring of flock health and mating practices, both of which are essential for ensuring consistent and sustainable egg production.

Hatchability

Hatchability is a critical reproductive performance indicator, measuring the percentage of fertilized eggs that successfully hatch. It serves as a direct reflection of not only the quality of the eggs but also the overall health of the reproductive system in the poultry. High hatchability suggests effective management and optimal conditions for reproduction (Zhao et al., 2021). The Mojosari X Mojosari breed demonstrates a hatchability rate of 71.36 ± 11.06%, which is the highest among the breeds in the table. This indicates that the genetic make-up of this breed results in eggs that are more likely to hatch successfully. The
relatively higher hatchability rate may also reflect the breed's genetic adaptability to its environment, making it a suitable choice for breeders aiming to maximize egg-to-chick conversion rates. In contrast, the Alabio X Alabio breed shows a lower hatchability rate of 64.58 ± 10.09%, which could be due to several factors. These may include lower egg quality or genetic factors that affect embryo development or shell strength, both of which can contribute to lower hatching success. The lower hatchability could also indicate that the Alabio X Alabio breed might require more careful management practices, particularly in terms of egg handling and incubation settings, to improve its reproductive performance (Karami et al., 2020). These findings emphasize the role of genetics in reproductive success, and genetic selection programs focused on enhancing egg quality and embryonic survival may help increase hatchability in this breed.

Furthermore, hatchability can be influenced by a range of external and internal factors, such as the age of the hens, environmental conditions during incubation, and the presence of diseases or stress in the flock. Karami et al. (2020) highlighted that optimal incubation conditions, including stable temperature and humidity, are critical to improving hatchability. The Mojosari X Mojosari

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breed's higher hatchability may be a reflection of its ability to thrive in controlled breeding environments, where environmental conditions and management practices are optimized. The high hatchability of Mojosari X Mojosari suggests that this breed has superior reproductive efficiency, which can make it an ideal candidate for breeding programs that aim to maximize productivity, particularly in commercial egg production. This breed's success in hatching can be further attributed to consistent egg quality, appropriate incubation practices, and potentially better adaptation to local environmental conditions. Therefore, optimizing incubation and management practices, such as temperature control and regular health monitoring of the breeding stock, could further enhance hatchability in this breed, leading to higher overall productivity.

Embrionic Mortality

Embryonic mortality is a significant factor in poultry breeding programs, as it directly affects the efficiency of egg production and overall reproductive performance. It refers to the failure of fertilized eggs to develop into viable embryos, which can be caused by various factors including genetic issues, poor egg quality, and suboptimal incubation conditions. In the provided data, the Alabio X Alabio breed exhibits the highest embryonic mortality rate at 35.43 ± 10.09%, indicating that this breed may face challenges related to embryo survival during incubation. This high mortality rate could be linked to genetic factors that predispose eggs to fail during early developmental stages. In contrast, the Mojosari X Mojosari breed, with a lower embryonic mortality rate of 28.65 ± 11.06%, appears to have better adaptability in ensuring embryo survival during the incubation process (Karami et al., 2020). The differences in embryonic mortality across breeds underscore the importance of genetic selection and management practices aimed at improving egg quality and incubation conditions. Embryonic mortality can often be reduced by improving the quality of eggs through better nutrition, disease control, and genetic improvements. Karami et al. (2020) emphasize that optimizing environmental factors such as temperature and humidity during incubation, along with selecting for more robust genetic traits, can significantly improve the chances of embryo survival. The lower embryonic mortality rate observed in the Mojosari X Mojosari breed suggests that this breed may possess genetic traits that enhance embryo viability, thus reducing the incidence of egg wastage and improving hatching rates. Such genetic traits are likely beneficial for commercial poultry breeding, where reducing egg wastage is crucial for maximizing production efficiency and profitability.

In addition to genetic factors, research has shown that management practices, such as proper handling of eggs and maintaining consistent incubation conditions, play a pivotal role in reducing embryonic mortality (Zhao et al., 2021). It is also important to monitor the age of the hens, as older hens may produce eggs with lower fertility and higher mortality rates (Siti et al., 2019). Thus, incorporating comprehensive management practices, along with genetic improvements, can lead to significant reductions in embryonic mortality and improve overall hatchability and reproductive success in poultry farms.

Quality of Day-Old Duck (DOD)

The quality of Day Old Ducks (DOD) serves as a critical indicator of hatching success and the growth potential of ducklings during the early stages of development. Assessment of DOD quality is generally based on several key parameters, including hatch weight, body length, and Pasgar score. Hatch weight reflects the embryo's ability to utilize the nutritional contents of the egg efficiently during incubation and serves as an early predictor of future growth performance. Body length indicates proper embryonic development and the suitability of incubation conditions. Meanwhile, the Pasgar score is a comprehensive evaluation that encompasses reflex response, beak condition, leg formation, abdominal integrity, and navel closure. A strong reflex response suggests optimal neural and muscular function, while a well-formed beak and symmetrical legs indicate normal organ development. A firm abdomen free of yolk residue implies efficient nutrient absorption, and a clean, properly closed navel denotes complete healing after hatching. Collectively, these parameters provide a holistic overview of the health status, viability, and growth potential of the DOD for subsequent rearing stages. The average value and standard deviation of Day Old Duck (DOD) quality of Alabio, Mojosari and FI cross ducks are presented in Table 2.

Table 2. Average Hatch Weight, Body Length, and Pasgar Score of Duck Genotypes AA, MM, and AM

Breed	Alabio X Alabio	Mojosari X Mojosari	Alabio x Mojosari
Hatch Weight (gr)	38,58 ± 1,07	37,51 ± 2,45	38,22 ± 0,59
Body Length (cm)	18,57 ± 0,15	18,88 ± 0,30	18,71 ± 0,26
Pasgar Score	9,74 ± 0,36	9,84 ± 0,19	9,80 ± 0,19

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Hatch Weight

The results of this study indicate that although there are differences in Day-Old Duck (DOD) weight among duck breeds, such as those recorded for the Alabio × Alabio (38.58 ± 1.07 grams), Alabio × Mojosari (38.22 ± 0.59 grams), and Mojosari × Mojosari (37.51 ± 2.45 grams) crosses, no significant effect was found between duck breeds and DOD weight ($P > 0.05$). A P value greater than 0.05 indicates that genetic variation between breeds does not significantly contribute to the weight differences of newly hatched ducks. Although there are numerical differences in weight between groups, external factors such as environmental conditions and maternal care play a more prominent role in determining DOD weight than genetics alone. This finding is consistent with Karami et al. (2020), who stated that genetic variation can affect certain physical traits, but does not always have a significant impact on initial weight in ducks.

The research conducted by Sudaryanto et al. (2021) adds that nutritional factors and maternal conditions during the incubation period have a greater impact on DOD weight than genetic factors. In their study, it was found that proper feed intake and good care during the incubation period could influence the growth and health of DODs at hatching. Thus, while genetic differences between duck breeds may influence certain aspects of reproduction, proper incubation care and environmental factors are more dominant in determining the initial weight of ducks. This highlights the importance of attention to external factors in poultry management and breeding efforts to improve hatch performance.

Body Length

The body length of DODs showed significant variation among the tested crossbreeds, with the Mojosari × Mojosari group recording the largest body length at 18.88 ± 0.30 cm, followed by the Alabio × Mojosari group at 18.71 ± 0.26 cm, and the smallest body length observed in the Alabio × Alabio group at 18.57 ± 0.15 cm. This difference suggests that genetic factors influence body size, although external factors such as nutrition and management conditions also play a role in determining DOD body length. Overall, body length can serve as an important indicator in genetic selection for improving duck growth and physical quality. Additionally, environmental factors such as feed quality, cage temperature, and cleanliness also affect the physical growth of ducks, making good management crucial for achieving optimal results.

According to research by Sadjadi et al. (2019), selecting the right breed is critical in obtaining optimal body size for DODs, as genetic differences between breeds can affect their physical growth capabilities. For example, the Mojosari × Mojosari group, which exhibited the largest body length, likely has a genetic advantage for faster body growth compared to other breeds. Furthermore, research by Soeprapto (2021) emphasizes that body length differences are influenced by a combination of genetic factors from the parents and proper feeding practices during the maintenance period. Therefore, appropriate genetic selection and good management practices can be used to enhance long-term duck breeding performance, producing ducks with optimal body sizes and increasing poultry productivity.

Pasgar Score

Although there were differences in body weight and body length parameters among the duck breeds tested, the results of this study show that the Pasgar score, which measures the health and vitality of ducks, did not show significant differences among the duck crossbreeds ($P > 0.05$). The Pasgar scores for Alabio × Alabio were recorded at 9.74 ± 0.36, for Mojosari × Mojosari at 9.84 ± 0.19, and for Alabio × Mojosari at 9.80 ± 0.19. These values indicate that despite variations in physical size, the health and vitality of ducks from all three crossbreeds were relatively similar. This suggests that genetic factors play a lesser role in the health quality of ducks compared to other factors.

Research by Karami et al. (2020) supports this finding, stating that despite differences in physical size such as body weight and body length, health scores measured by parameters like Pasgar tend to remain stable across groups. This is attributed to other factors such as care, feed quality, and the supportive environment that promote the overall physical health and vitality of poultry. Further research by Fitriani et al. (2021) also shows that management practices, including cage cleanliness, controlled temperatures, and proper feeding, have a greater influence on poultry health than the genetic influence of specific breeds. In other words, within the context of this study, while duck breeds may show differences in physical size, environmental factors and good management practices play a more decisive role in maintaining the health and vitality of ducks.

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CONCLUSION

In conclusion, this study highlights the significant role of genetic selection and management practices in improving poultry breeding outcomes. Symmetrical eggs, such as those from the Alabio X Alabio breed, promote better hatchability by facilitating uniform heat distribution during incubation. Similarly, egg weight plays a crucial role in embryo development, with larger eggs like those from Mojosari X Mojosari providing more nutrients, though excessively large eggs may lead to hatching challenges. Fertility and hatchability rates were higher in the Alabio X Alabio and Mojosari X Mojosari breeds, respectively, indicating the importance of genetic compatibility and optimal incubation conditions. Additionally, embryonic mortality rates revealed the impact of genetic traits on embryo survival, emphasizing the need for genetic selection and improved environmental management to enhance reproductive success and productivity in poultry farming.

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