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Second-Generation Crossbreeding of Native Wareng and Lurik Chickens for the Improvement of Egg Production Performance

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Abstract. Native chickens are crucial to Indonesia's rural economy, providing income and protein, but their egg production is lower than commercial layers. This study aimed to evaluate the egg production performance of second-generation (F_2) crossbreed between Wareng and Lurik native chickens. The experiment was conducted with four treatments: (1) Wareng chickens (W); (2) Lurik chickens (L); (3) crossbred chickens from Wareng males and Lurik females (WL); and (4) crossbred chickens from Lurik males and Wareng females (LW). Each treatment consisted of 10 chickens. The observed variables included hen_day_production (HDP), egg weight, egg length, egg width, egg index, and eggshell color. The study was carried out for 12 months (January–December). HDP data were averaged monthly, while the other variables were calculated by annually. The data were analyzed descriptively. The results showed that purebred Wareng and Lurik native chickens had higher HDP compared with their crossbred counterparts, whereas the crossbreds produced heavier eggs. Heterosis was more evident in the first generation (F1), while the second generation (F_2) exhibited genetic segregation that led to greater variation in egg production. These findings indicate that further selective breeding is required to optimize the genetic combination for improving the egg production performance of native chickens.

1 Introduction

Native chickens (ayam kampung) play an important role in the livelihoods of rural communities in Indonesia. Their presence not only serves as a relatively affordable and easily accessible source of animal protein but also contributes directly to household income. For many rural families, raising native chickens often functions as a form of savings or small-scale investment that can be sold at any time to meet urgent needs. Consequently, native chickens hold significant economic, social, and even cultural value within Indonesian society.

Indonesia is known to have more than 31 native chicken strains distributed widely from Aceh to Papua [1, 2]. This diversity reflects the richness of local poultry genetic resources,

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which constitute valuable national assets. Each strain of native chicken possesses distinctive characteristics in terms of appearance, adaptability, and production potential. Two such strains that are relatively well-known are the Wareng chicken and the Lurik chicken. Both are considered dual-purpose breeds, meaning they can be utilized as sources of both meat and eggs [3, 4, 5]. This dual-purpose trait makes native chickens versatile in supporting household food security and nutrition, particularly in rural areas where dietary needs and consumption patterns are varied.

Compared to commercial breeds, native chickens demonstrate better adaptability to tropical environments. They can withstand high ambient temperatures and survive under simple management systems. In contrast, commercial broilers (Gallus gallus domesticus) are highly sensitive to heat stress. Broilers may experience stress and even mortality if raised under environmental temperatures exceeding 36°C for more than eight hours per day [6]. This highlights the genetic advantage of native chickens, including Wareng and Lurik, in terms of heat tolerance. Interestingly, previous studies reported that Wareng and Lurik chickens show no significant differences in their blood profiles [7]. This suggests strong potential for crossbreeding between the two strains to produce progeny with improved productive performance.

Despite these adaptive advantages and genetic diversity, native chickens generally have lower egg production compared to commercial layers. Egg production performance is strongly influenced by the rearing system. Native chickens maintained under extensive management systems only achieve a Hen Day Production (HDP) rate of approximately 13%. Under semi-intensive management, HDP may increase to around 29%, while intensive systems can further raise HDP to about 40% [2]. Nevertheless, these figures remain far below those of commercial laying hens, which can reach an HDP of about 95.99% at peak production [8]. The remarkable productivity of commercial layers is largely the result of long-term selective breeding and crossbreeding programs that have generated genetically stable and highly productive final stocks.

The wide productivity gap between native chickens and commercial breeds underscores the need for improvement programs in native chicken development. One viable strategy is crossbreeding among native strains with specific advantageous traits. Such crossbreeding efforts are expected to produce new generations of native chickens with enhanced production performance in terms of egg yield, growth rate, and overall adaptability.

To date, studies specifically evaluating the Hen Day Production (HDP) of Wareng and Lurik chickens are very limited and, in fact, have not been reported. Likewise, there is no available information regarding the outcomes of crossbreeding between Wareng and Lurik chickens. This lack of scientific evidence highlights the importance of conducting research to evaluate the production performance of crossbred Wareng–Lurik chickens. Therefore, the present study aims to investigate the production performance of second-generation Wareng–Lurik crossbred chickens. It is expected that this research will provide valuable scientific information to support the development of superior native chickens in Indonesia, characterized by higher productivity, adaptability, and competitiveness.

2 Materials and Methods

2.1 Material

The study was conducted at the Experimental Farm, Department of Animal Science, University of Muhammadiyah Malang. A total of 40 native chickens were used, consisting of 10 Wareng chickens (W), 10 Lurik chickens (L), 10 crossbred chickens from Wareng males and Lurik females (WL), and 10 crossbred chickens from Lurik males and Wareng females (LW). Commercial feed was provided as the diet, and stationery was used for data recording. This research was carried out under the Ethical Approval No. 5.a./048.a/KEPK-UMM/III/2022 issued by the Faculty of Medicine, University of Muhammadiyah Malang.

2.2 Research design

This study was conducted experimentally with four treatments: (1) Wareng chickens (W); (2) Lurik chickens (L); (3) crossbred chickens from Wareng males and Lurik females (WL); and (4) crossbred chickens from Lurik males and Wareng females (LW). The observed variables included hen day production (HDP), egg weight, egg length, egg width, egg index, and eggshell color. The experiment was carried out for 12 months (January–December). HDP data were averaged monthly, while the other variables were calculated as annual means.

2.3 Rearing management

Rearing was carried out for 12 months with a semi-intensive cages system. Commercial feed was given as much as 120 g d-1 which was divided into two times, namely morning 40 % and afternoon 60 % of feed. Morning feeding was carried out at 07.00 to 08.00 am and in the afternoon, it was given at 15.00 to 16.00 pm. Drinking water was provided ad-libitum. Vitamins were given every 3 d. During the rearing process no vaccinations were carried out. Cleaning of farm was carried out every day at 07.00 to 08.00 am. During the day a fan was provided to regulate air circulation.

2.4 Data collection and statistical analysis

The data obtained were subsequently averaged and analyzed using descriptive statistics.

3 Results and Discussion

The results of the hen day production (HDP) observations from the second-generation crossbreeding of native Wareng and Lurik chickens for improving production performance are presented in Table 1 and Figure 1.

The higher HDP in pure strains may reflect greater genetic stability. Conversely, uncontrolled segregation in the F_2 generation often leads to variation and partial loss of hybrid vigour. Effective selection across successive generations is therefore required to maintain performance improvements.

Table 1. Average hen day production (HDP) of second-generation (F_2) crossbred native Wareng and Lurik chickens

Months	HDP (%)			
	WL	LW	W	L
January	36.8	43.48	46.67	50
February	57.04	38.33	55.02	58.04
March	47.62	26.56	54	55.83
April	62.75	43.75	58.79	55.83
May	57.97	47.22	55.02	50
June	50	36.67	56.39	53.33
July	27.17	52.78	56.39	50.00
August	53.97	45.45	55.02	60
September	51.67	53.33	53.37	50
October	63.64	47.22	60.03	58.62
November	46.97	36.67	50.03	60
December	40.97	43.75	59.55	62.5
Average	49.71	42.93	55.02	55.35

Note: WL = crossbred native chickens from Wareng males and Lurik females; LW = crossbred native chickens from Lurik males and Wareng females; W = Wareng; L = Lurik

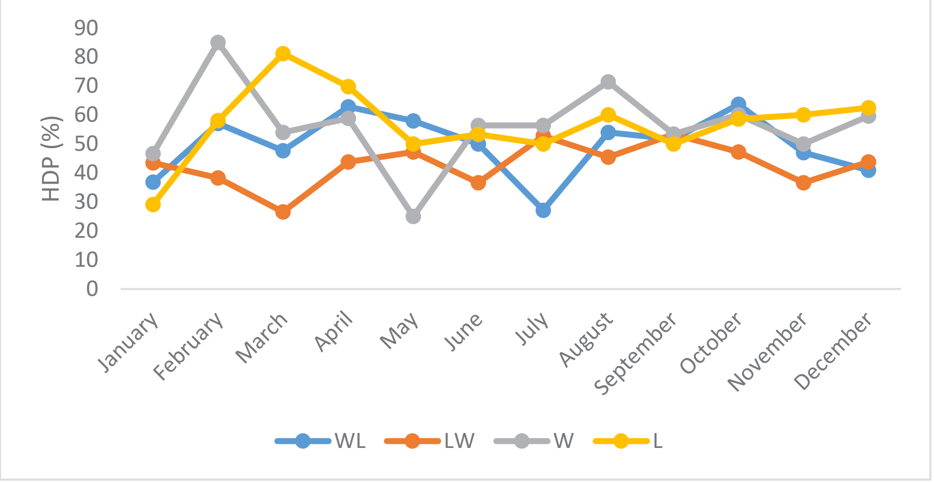

Fig. 1. Average monthly egg production

The results of the present study clearly demonstrated that the purebred Wareng (55.02%) and Lurik (55.35%) chickens exhibited superior Hen Day Production (HDP) compared with the F_2 crossbreds (WL = 49.71%, LW = 42.93%). This finding indicates that the productive performance of the F_2 generation declined relative to the parental strains, suggesting that the heterosis effect typically expressed in the first-generation (F_1) hybrids was not retained in the subsequent generation. In most crossbreeding programs, F_1 individuals often exhibit hybrid vigor because of favorable gene combinations and dominance effects [9]. However, as these individuals interbreed to produce the F_2 generation, genetic segregation and recombination occur, disrupting the optimal allelic combinations established in the F_1 hybrids.

This reduction in heterosis observed in the F_2 Wareng–Lurik crossbreds can be attributed to the random assortment of alleles and recombination events that lead to greater genetic variability but reduced uniformity in performance. The breakdown of favorable epistatic interactions that were present in the F_1 generation further contributes to the observed decline in HDP. Such phenomena are well documented in poultry breeding, where the superior performance of F_1 crosses often diminishes in later generations unless selective breeding is implemented to fix advantageous genetic combinations. Therefore, the observed decline in HDP among F_2 chickens highlights the importance of understanding the genetic mechanisms underlying heterosis and the necessity of applying structured selection programs to sustain productivity improvements across generations.

Consistent with these findings, Negash et al. [10] also reported that crossbreeding between different poultry strains produced lower Hen Day Production (HDP) compared with their respective parental strains. This consistency across studies reinforces the notion that crossbreeding alone does not guarantee permanent productivity gains, as heterosis tends to diminish without appropriate selection pressure. The implication for native chicken development programs in Indonesia is clear: while crossbreeding can serve as an effective strategy for introducing genetic diversity and achieving short-term improvements, long-term genetic progress depends largely on systematic selection, stabilization of desirable alleles, and careful management of breeding populations. By integrating these strategies, it is possible to enhance both the productivity and genetic sustainability of indigenous chicken breeds.

The egg characteristics produced by the second-generation crossbreeding between Wareng and Lurik chickens are presented in Table 2.

Table 2. Egg characteristics of second-generation (F_2) Wareng–Lurik crossbred chickens

Egg Characteristics	Strain			
	WL	**LW**	**W**	**L**
Egg weight (g)	52.3	50.2	47.42	44.39
Egg length (mm)	52.35	50.3	51.89	49.89
Egg width (mm)	38.28	37.95	38.27	37.63
Egg Index	0.73	0.74	0.74	0.76
Eggshell Colour	White	White-Brownish	Brownish-White	slightly brownish white

Note: WL = crossbred native chickens from Wareng males and Lurik females; LW = crossbred native chickens from Lurik males and Wareng females; W = Wareng; L = Lurik

The increase in egg weight observed in the F_2 crossbred chickens compared with the purebred strains may be attributed to several genetic and physiological factors. Although heterosis for quantitative traits such as Hen Day Production (HDP) often declines in later generations due to genetic segregation and recombination, favorable allelic combinations affecting egg size may still be retained or reconstituted in certain individuals of the F_2 population. Ni et al. [11] reported that both crossbreds showed significant heterosis for egg weight, except for first egg weight, ranging from 1.9 to 9.0% (FDR $\leq$ 0.01) and the egg weights of YW and WY were higher than the best parental breed, WW, from 56 and 76 weeks of age, respectively, indicating that positive gene interactions influencing nutrient deposition and albumen synthesis can persist beyond the F_1 generation. Similarly, Soliman et al. [12] found that both crossbreds (AL and LA) significantly laid heavier eggs than the local strain (AA) (53.14 and 52.29 g vs. 47.47 g), confirming that crossing between genetically diverse lines can enhance egg size.

Consistent findings were also reported by Sarma et al. [13], who observed that crossbred layers exhibited higher egg weights at both 40 and 52 weeks of age compared with purebred strains, suggesting that heterosis for egg size can be maintained over time. Moreover, a comprehensive review by Mokoena et al. [14] concluded that crossbreeding between indigenous and exotic chicken breeds frequently results in larger egg size despite a decline in laying rate, emphasizing the compensatory balance between egg number and egg weight. Likewise, Soliman et al. [12] demonstrated that crossbred chickens derived from local and commercial lines produced significantly heavier eggs while maintaining acceptable quality standards. Collectively, these findings support the notion that reduced HDP in crossbred chickens may be offset by increased egg mass through favourable genetic and physiological mechanisms.

From a production standpoint, this compensatory relationship is economically advantageous, as larger eggs typically command higher prices in local markets. Thus, the increase in egg weight among F_2 Wareng–Lurik crossbreds not only reflects a physiological adjustment but also represents a potential improvement in product quality that can be exploited in selective breeding programs aimed at enhancing the productivity and economic value of indigenous chickens.

The evaluation of egg morphometric traits revealed slight variations among the different chicken strains. The egg length of the F_2 crossbreds (WL = 52.35 mm; LW = 50.3 mm) was generally comparable to that of the purebreds, with WL showing the greatest value, indicating that the Wareng maternal line may have contributed to elongation of egg shape. Egg width exhibited minimal variation across strains (ranging from 37.63 mm to 38.28 mm), suggesting that crossbreeding had limited influence on lateral egg dimensions. Consequently, the egg index values (ratio of width to length) were relatively uniform among strains, ranging from 0.73 to 0.76, which classifies all eggs as having a normal ovoid shape suitable for incubation and handling. Minor differences in eggshell color were also observed, where WL and LW crossbreds tended to produce lighter shells (white to light brown) compared with the purebreds, particularly Lurik chickens, which exhibited a more brownish hue. This variation in shell pigmentation likely reflects genetic inheritance from both parental strains, with dominance of lighter shell color genes from the Wareng line. Overall, these findings suggest that crossbreeding only modestly affected egg shape and shell characteristics, maintaining uniformity desirable for market and reproductive performance.

4 Conclusion

Based on the findings of this study and in comparison, with previous research, it is evident that the second-generation crossbreeding (F_2) of Wareng and Lurik native chickens still faces challenges in maintaining optimal egg production. However, the crossbred chickens demonstrated an advantage in producing larger egg sizes. Therefore, more targeted breeding strategies are required to develop chickens with optimal production performance in accordance with the needs of the poultry industry.

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