SHORT COMMUNICATION

Estimation of Genetic Parameters of Important Economic Traits in Ankaleshwar Breed of Chicken

Fulabhai P. Savaliya[1], Atul B. Patel[1], Nikesh J. Bhagora[1], Dhavalkumar F. Chaudhary[1*]

Abstract

The present investigation was carried out with the performance records of Ankaleshwar birds spanning one generation to estimate genetic parameters of economically important traits. A mixed linear model was employed for the analysis, incorporating sire as a random effect and mean as fixed effect. The performance traits included age at first egg (AFE), egg weight at 28 weeks of age (EW28) and 40 week of age (EW40), body weight at 16 weeks of age (BW16) and 40 weeks of age (BW40), egg number up to 40 weeks (TEN40). Highly significant ($p \leq 0.01$) effect of sire was observed on all traits, except EW28 and EW40. The least squares means for performance traits AFE, EW28, EW40, BW16, BW40 and TEN40 were 150.78±0.38 days, 38.22±0.10 g, 42.94±0.10 g, 962.21±4.07 g, 1556.20±7.01 g and 83.47±0.51 eggs, respectively. The heritability estimates were low to moderate for all the traits. The age at first egg was negatively associated with egg weight at 40 weeks (r=-0.81) and total egg production up to 40 weeks (r=-0.67). Further, body weight at 16 weeks of age had strong association with body weight of 40 weeks (r=0.93). There were positive genetic associations of egg weight at 40 weeks with body weight at 40 weeks (r=0.74) and total egg production up to 40 weeks (r=0.50). These findings emphasize that incorporating early measurable traits and key reproductive indicators along with their correlated responses is essential for developing an efficient and sustainable breeding programme to improve egg production and overall productivity in Ankaleshwar breed of chicken.

Key words: Ankaleshwar poultry, Body weight, Egg production, Egg weight, Heritability.

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Introduction

Poultry production is the fastest-growing sub-sector of Indian agriculture with a major change in structure and operations in the poultry sector. India ranks among the top two egg-producing countries in the world. India produced an estimated 149.11 billion eggs during 2024-25, making it 2nd globally in egg production with per capita availability of 106 eggs per annum (BAHS, 2025). Native chicken breeds represent a vital genetic resource for rural economies, particularly in developing countries due to their superior adaptation to harsh environmental conditions, resistance to diseases and unique meat and egg flavour profiles (Tongsiri *et al.*, 2019; Boonkum *et al.*, 2021). Despite these advantages, indigenous chickens often exhibit lower productivity, characterized by slower growth rates and reduced egg-laying capacity compared to commercial high-yielding breeds. The implementation of systematic breeding programs is therefore essential to enhance their performance while maintaining their adaptive traits (Suyatno *et al.*, 2024).

India has now 21 indigenous chicken breeds that have been characterized and registered (NBAGR, 2025). Among which, Gujarat has 3 registered chicken breeds, *viz.,* Ankaleshwar, Busra and Aravali. Ankaleshwar chicken is the native of Bharuch and Narmada districts. The name of the breed was derived from the area "Ankaleshwar" in the Bharuch district of Gujarat. The breeding area also extended to Jumbusar, Zagadia, Bharuch, Hansot and Valia in the Bharuch district, as well as Dediapada, Rajpipla, Tilakwada and Nadod in the Narmada district of Gujarat. These poultry birds are mainly kept by tribes under backyard poultry farming as a source of livelihood and income. This breed is also referred to as Desi, Gowrani, Gamthi, Jumbusar, Zagadia, Hansot, Valia, Dediapada, Rajpipla, Tilakwada and Nadod, as these are the parts of the breeding tract (Yadav *et al.*, 2017). However, limited information is available on the productive, reproductive and genetic architecture of Ankaleshwar chicken. The absence of comprehensive data on genetic and phenotypic parameters of economically important traits highlights the need for systematic evaluation of this indigenous breed. Knowledge of these parameters is essential for designing effective

[1]Poultry Research Station, College of Veterinary Science & Animal Husbandry, Anand-388110, Kamdhenu University, Gujarat, India

Corresponding Author: Dr. D. F. Chaudhary, Assistant Professor, Poultry Research Station, College of Veterinary Science & Animal Husbandry, Anand-388110, Kamdhenu University, Gujarat, India. e-mail: dfchaudhary@kamdhenuuni.edu.in

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selection and breeding programmes aimed at genetic improvement and conservation. Therefore, the present study was undertaken to evaluate the genetic worth as well as estimating genetic and phenotypic correlation among different traits in Ankaleshwar, indigenous breed of chicken.

Material and Methods

The present study was based on data collected from Ankaleshwar birds maintained at Poultry Research Station, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Anand (Gujarat, India) under the scheme entitled "ICAR-AICRP on Poultry Breeding". All records were obtained from a single generation. Individual birds were housed in individual cages and identified using wing bands. Standardized feeding and management practices were followed, along with the routine vaccination schedule implemented at the farm.

Traits Recorded

The traits assessed in the present study comprised age at first egg (AFE), defined as the number of days from hatching to the laying of the first egg by the pullet. Egg weight at 28 weeks (EW28) and 40 weeks (EW40) was recorded as the average weight of three successive eggs produced by each bird at the respective ages. Body weight at 16 weeks (BW16) and 40 weeks (BW40) was measured individually using a digital weighing balance. Laying performance was further evaluated by calculating the total number of eggs produced up to 40 weeks of age (TEN40).

Statistical Analysis

Data pertaining to growth and egg production traits were analyzed using a mixed-model least squares analysis of variance in conjunction with a maximum likelihood procedure, following the methodology described by Harvey (1990). Heritability estimates for the traits under investigation were obtained using the paternal half-sib correlation method. Genetic and phenotypic correlations among traits were estimated from sire component variance–covariance matrices derived from the fitted statistical model.

$$Yik = \mu + Si + eik$$

Where, Yik = Value of a trait measured on the k^{th} individual belonging to the i^{th} sire, μ = Population mean, Si = Random effect of the i^{th} sire, eik= Random error associated with each and every observation and assumed to be normally distributed with mean zero and variance σ2e.

Results and Discussion

In Ankaleshwar female birds, the least squares mean estimates for age at first egg (AFE), egg weight at 28 weeks (EW28), egg weight at 40 weeks (EW40), body weight at 16 weeks (BW16), body weight at 40 weeks (BW40) and total egg number up to 40 weeks (TEN40) were 150.78±0.38 days, 38.22±0.10 g, 42.94±0.10 g, 962.21±4.07 g, 1556.20±7.01 g and 83.47±0.51 eggs, respectively. The combined least-squares analysis of variance revealed that the sire effect was statistically significant ($p \leq 0.05$) for several traits indicating the presence of additive genetic variation among sires for traits, *viz.,* AFE, BW16, BW40 and TEN40.

The age at first egg (AFE) observed in the present study was lower than all the reported values in earlier studies, which ranged from 157.01 to 214.39 days across RIR, Aseel, Kadaknath, Vanaraja, Grampriya and Uttara breeds (Meena *et al.*, 2023; Dalal *et al.*, 2022; Pandey *et al.*, 2022; Rajkumar *et al.*, 2020[a,b]; Rathi *et al.*, 2024; Singh *et al.*, 2018). The earlier onset of laying in the present population indicates better sexual maturity and adaptability for improving egg production and reproductive efficiency.

The egg weights at 28 weeks (EW28) and at 40 weeks (EW40) in the present study were comparable to earlier reports and found to be in accordance with Aseel and Kadaknath (Pandey *et al.*, 2022). However, the present estimate was lower than RIR, Vanaraja and Grampriya chicken (Meena *et al.*, 2023; Rajkumar *et al.*, 2020[a,b]). This suggests that the egg weight at early laying stage in the present birds falls within the normal biological range for indigenous and dual-purpose breeds.

The body weight at 16 weeks (BW16) was higher than earlier reports in Aseel and Kadaknath (Dalal *et al.*, 2022). The body weight at 40 weeks (BW40) recorded in the present study was comparable to RIR, Aseel, Kadaknath and Uttara chicken (Meena *et al.*, 2023; Dalal *et al.*, 2022; Pandey *et al.*, 2022; Singh *et al.*, 2018). However, it was lower than the body weight reported for Vanaraja and Grampriya (Rajkumar *et al.*, 2020[a,b]) as well as Aseel (Rathi *et al.*, 2024, Dalal *et al.*, 2022). These findings categorize the Ankaleshwar as medium-body weighted, indicating their suitability for dual-purpose utilization under rural and semi intensive production systems.

The total egg number up to 40 weeks (TEN40) in the present study was higher than all the values reported in earlier studies, which ranged from 35 to 80 eggs in RIR, Aseel, Kadaknath, Vanaraja, Grampriya and Uttara chicken (Meena *et al.*, 2023; Dalal *et al.*, 2022; Pandey *et al.*, 2022; Rajkumar *et al.*, 2020[a,b]; Rathi *et al.*, 2024; Singh *et al.*, 2018). The superior egg production observed in the present study highlights the enhanced laying efficiency of the Ankaleshwar birds and indicates their strong potential for improved productivity in backyard and semi-intensive poultry farming systems.

Table 1: Heritability (at the diagonal), genetic (above the diagonal) and phonotypic (below) correlation coefficients for various traits

Traits	AFE	EW28	EW40	BW16	BW40	TEN40
AFE	0.23±0.28	0.007	-0.814	-0.327	0.280	-0.671
EW28	0.025	0.03±0.06	0.178	0.158	0.061	-0.328
EW40	0.013	0.061	0.04±0.06	-0.309	0.740	0.504
BW16	-0.029	0.057	0.009	0.37±0.09	0.932	0.165
BW40	0.086	0-.000	0.062	0.340	0.18±0.07	-0.216
TEN40	-0.261	0.012	0.005	-0.022	0.019	0.12±0.07

Heritability Estimation

The heritability estimate of AFE, EW28, EW40, BW16, BW40 and TEN40 were 0.23±0.28, 0.03±0.06, 0.04±0.06, 0.37±0.09, 0.18±0.07 and 0.12±0.07, respectively (Table 1).

The heritability estimate for age at first egg (AFE) was moderate and comparable with earlier findings including RIR (Meena *et al.*, 2023), Aseel (Dalal *et al.*, 2022; Rathi *et al.*, 2024), and Kadaknath (Pandey *et al.*, 2022). However, it was found to be lower in Aseel (Pandey *et al.*, 2022), Vanaraja (Rajkumar *et al.*, 2020[a]) and higher than in Kadaknath (Dalal *et al.*, 2022), Grampriya (Rajkumar *et al.*, 2020[b]). This indicated that the trait is under moderate genetic control and offers reasonable scope for improvement through selection.

The heritability of egg weight at 28 weeks (EW28) and 40 weeks (EW40) in the present study was found to be low. The present estimates were lower than most indigenous breeds reported including Aseel, Kadaknath, Vanaraja, Grampriya, Uttara chicken (Dalal *et al.*, 2022; Pandey *et al.*, 2022; Rajkumar *et al.*, 2020[a,b]; Rathi *et al.*, 2024; Singh *et al.,* 2018). The lower estimate indicates that egg weight in the present population is largely influenced by environmental factors.

The heritability estimate for body weight at 16 weeks (BW16) in the present study was comparable and slightly higher than previously reported estimates of Aseel and Kadaknath (Dalal *et al.,* 2022). This moderate to high heritability suggests that juvenile body weight is under considerable genetic control, offering good potential for improvement through selection. In contrast, the heritability estimate for body weight at 40 weeks (BW40) in the present study was lower than most reported values across different chicken (Dalal *et al.*, 2022; Pandey *et al.*, 2022; Rajkumar *et al.*, 2020[a,b]; Rathi *et al.*, 2024; Singh *et al.*, 2018). This lower estimate suggests that present population is more strongly influenced by environmental factors, reducing the expected response to direct selection.

The heritability estimate for total egg number up to 40 weeks (TEN40) in the present study was comparable with Kadaknath (Dalal *et al.*, 2022), Uttara chicken (Singh *et al.*, 2018), Vanaraja and Grampriya (Rajkumar *et al.*, 2020[a,b]). However, it was found to be lower than Aseel (Dalal *et al.*, 2022; Pandey *et al.*, 2022, Rathi *et al.*, 2024) and quite higher than in RIR (Meena *et al.*, 2023). Thus, it is moderately influenced by environmental factors, and genetic improvement may require a combination of selection and improved management.

Genetic and Phenotypic Correlations

The genetic correlations (Table 1) showed AFE had a strong negative association with EW40 (r=-0.81) and TEN40 (r=-0.67), indicating that birds maturing earlier are genetically superior in later egg production and performance. Further, strong positive genetic correlations were observed between BW16 and BW40 (r=0.93) suggesting that selection for early growth will lead to simultaneous improvement in adult body weight. Positive genetic associations of EW40 with BW40 (r=0.74) and TEN40 (r=0.50) further support the possibility of improving production traits together. In contrast, the phenotypic correlations were generally low to moderate, implying that environmental factors such as nutrition, management and health conditions tend to mask the true genetic relationships among traits. Overall, the results indicate that while favourable genetic correlations provide good scope for simultaneous genetic improvement of growth and egg production traits, effective management practices are essential to realize these genetic gains at the phenotypic level. However, the direction of relationships observed was consistent with earlier studies of Aseel and Kadaknath (Dalal *et al.*, 2022; Rathi *et al.*, 2024).

Conclusion

The present study explained the genetic architecture of key reproductive, growth and production traits in Ankaleshwar chicken by quantifying heritability with the genetic and phenotypic relationships among economically important traits. The findings provide a sound scientific basis for developing breeding programmes that integrate early growth, reproductive efficiency and egg production traits, thereby contributing to sustainable genetic improvement and enhanced productivity of Ankaleshwar chicken populations.

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