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Heterotic components for egg production traits and egg qualities in crossbreeding experiment of Saudi chickens with White Leghorn using multi-trait animal models

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Abstract: **1.** Three-year crossbreeding experiment involving Baladi Saudi (**S**) and White Leghorn (**L**) chickens was carried out in El-Qassim region in Saudi Arabia to evaluate the egg production performance and egg quality traits of the resulting crossbreds.
2. Data of age at first egg, first three-month egg production (**EP3**), annual egg production (**AEP**), egg weight (**EW**), albumen weight of egg (**AW**), yolk weight (**YW**) and shell weight (**SW**) were collected on 696 hen.
3. The genetic model of **Dickerson** under multi-trait animal model was used to estimate the heterotic components of this experiment in terms of direct ($\mathbf{G^I}$) and maternal ($\mathbf{G^M}$) additive effects, direct ($\mathbf{H^I}$) and maternal ($\mathbf{H^I}$) heterosis, and direct recombination loss ($\mathbf{R^I}$).
4. Variance components, heritabilities and breeding values for these egg traits were predicted using **DFREML** procedure of multi-trait animal model.
5. Hens of **L** breed had superior performance in egg production and egg qualities traits compared to the **S** hens.
6. Percentages of direct additive genetic variance (σ_A^2) for egg traits were moderate or high. Heritabilities of **AFE**, **EP3** and **AEP** were larger than those of egg quality traits. Estimates of heritability ranged from 0.31 to 0.55 for egg production traits, while they ranged from 0.22 to 0.29 for egg quality traits.
7. The ranges in breeding values for birds with and without records for egg traits were generally moderate or high. The accuracies of **PBV** were high and nearly similar for most traits studied.
8. The direct additive effects considerably affected most traits. **L**-sired hens had high direct additive effects ($\mathbf{G^I}$) compared to the S-sired hens for all traits studied.
9. Additive maternity ($\mathbf{G^M}$) for studied traits was cosiderable and in favour of the **S** breed since hens produced from **S**X**L** matings had better egg production than those produced from **L**X**S** matings.
10. Crossbred hens recorded positive direct heterosis for some egg production traits and negative $\mathbf{H^I}$ for egg quality traits. The percentage of $\mathbf{H^I}$ was about 3.2% for egg production traits, while they ranged from –14.0 to –2.5% for egg quality traits.
11. Estimates of $\mathbf{H^M}$ for **EP3** and **AEP** in daughters of crossbred dams were positive along with favourable negative $\mathbf{H^M}$ for **AFE**.
12. Direct recombination losses ($\mathbf{R^I}$) in crossbred hens for **AFE, EP3** and **AEP** were –4.7 days, 1.31 egg and 4.09 egg, respectively.

Keywords: Saudi chickens, Crossbreeding, Heterotic components, egg production, egg qualities.