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Comparative Analysis of Variation in Humoral Immunity, Production, Fitness and Feed Efficiency Traits in Chicken Performing in the Tropical Environment

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Abstract

This meta-analysis aimed to assess genetic and environmental effects on humoral immunity in comparison to production, fitness and efficiency trait classes in chicken. Three hypotheses were formulated; associations between heritability with genetic and environmental variances across the trait classes are equal; genetic and environmental effects on the trait classes are equal; study characteristics have no effect on genetic parameters in humoral immunity. Genetic parameters and production system characteristics were extracted from a total of 85 peer-reviewed articles published between 1976 and 2020. Mean standardised genetic variance (CVA) and environmental variance (CVR) were used to compare variances of traits measured in different units. Associations between the effect sizes were explored using spearman-rank correlation (non-normal distribution). For heterogeneity tests, hierarchical model was considered while study characteristics influencing genetic parameters in humoral immunity were tested by fitting hierarchical meta-regression model; log-transformed effect sizes used as response variables but back-transformed when reporting results. Associations between heritability with CVA and CVR was trait dependent. In humoral immunity and fitness traits, heritability was positively ($p < 0.05$) associated with CVA ($r = 0.34$ vs 0.30) For production traits, however, heritability was highly and negatively associated with CVR than with CVA ($r = -0.41$ vs 0.11 ; $p < 0.05$). Heterogeneity tests showed significant ($p < 0.05$) variation in effect sizes across trait classes. Weighted estimates of effect sizes indicate that humoral immunity had highest genetic (12%) and residual (23%) effects but with low heritability (0.23). In contrast to immunity traits, production traits had the highest heritability ($h^2 = 0.27$) but the least genetic (7%) and residual (9%) effects. Adjusting for moderating factors on humoral immunity, the two arms of humoral immunity, chicken population and production phase were able to explain the 93.1% of the between study variation in heterogeneity in CVA. Significant differences on genetic parameters across trait classes suggest presence of sub-groups among chicken performing in different production environments. Based on humoral immunity, accounting for these sub-grouping effects gives a better indication of true genetic effects in the different traits.

Keywords: Feed efficiency, fitness, genetic parameters, humoral immunity, production

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