GENETIC PARAMETER ESTIMATION OF GROWTH AND REPRODUCTIVE TRAITS OF BOHOLANO NATIVE CHICKEN

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ABSTRACT

The aim of this study was to estimate the genetic parameters of the growth and reproductive characteristics of Boholano native chicken. Genetic parameters for economically significant traits were calculated using the REML method of SAS 9.1. Data used were from three generations of Boholano native chicken raised at Ubay stock Farm, Ubay, Bohol. Estimated value of heritability for body weight at various ages (BW1, BW21, BW45, BW75, BW100 and BW120) ranged from 0.05 to 0.28 while heritability for reproductive traits were 0.15, 0.07 and 0.03 for EW, fertility and hatchability. Genetic correlation for body weights at different ages showed low to high positive correlation (0.10 to 0.84). Meanwhile, correlation of body weight to EW, fertility and hatchability were 0.15 to -0.70. Conclusively, the magnitude of heritability for reproductive traits were lower than the heritability for growth traits. Nonetheless, results of this study are an important basis of selection for genetic improvement of local chicken in the Philippines.

Keywords: heritability, genetic correlation, Philippine native chicken

INTRODUCTION

Native chickens are kept by smallholder farmers for multiple functions. They have essential contribution to the life of rural households (Mengesha and Tsega, 2011; Firozjah *et al*., 2015) and contribute significantly to food security (Al-Qamashoui *et al*., 2014; DOST-PCAARRD, 2016), serves as additional source of income (Buranawit *et al*., 2016); and a good source of high-quality protein (Lambio *et al*., 2000; Vali, 2008; Udoh and Isaac, 2014; Padhi, 2016; Ferdaus *et al*., 2016) for human consumption**.** Native chickens (*Gallus gallus domesticus* L.) are the usual domesticated fowl found in the backyard of households in the countryside (DOST-PCAARRD, 2012; Salces *et al*., 2013) and raised under traditional management systems so that they can be produced more economically.

Bolinao, Banaba, Darag, Camarines and Paraoakan are the few groups of local chickens that were documented in the Philippines (Lambio, 2010). Boholano chicken, a newly described strain of Philippine native chicken (Salces *et al*., 2013) is predominantly of single comb, with yellow shank, red-plain plumage, white skin and orange iris. The roosters

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are heavier and have higher body measurements than the female. (Salces *et al*., 2015).

Genetic parameter describes the genetic structure of the population. Therefore, genetic parameter estimation is vital for planning and implementing efficient breeding programs (Ayalew *et al*., 2017) and important indicator for an optimized response to genetic selection (Lopez *et al.,* 2019). Knowledge on genetic parameters for traits of interest is very crucial in artificial selection which culminates in genetic improvement using appropriate breeding programs (Adeleke *et al*., 2011). The limited data on genetic parameters and variance components holdback the improvement of genetic traits because information of this is essential for the correct estimation of breeding values (Shadparvar and Enayati, 2012).

Limited information is available and no research has been conducted on genetic component estimation of the growth and reproductive traits of Boholano native chicken. This study therefore is necessary as reference for future studies and of significant contribution to the animal sector since genetic evaluation is useful in establishing breeding programs.

MATERIALS AND METHODS

Data Collection

Data utilized for the purpose were from the results of two projects namely Community-based native chicken conservation, development and utilization for meat and egg production project of the Province of Bohol and Purification, Improvement and Sustainable Utilization of Native Chicken Strains in Bohol, Bicol and Zamboanga Peninsula. The data used to estimate the growth trait of Boholano chicken were generated from the established 12 families comprising 60 females and 12 males while estimates of reproductive characteristics such as fertility and hatchability of Boholano chicken were collected from 240 females from pre-selected stock, foundation stock, generation 1, generation 2 and generation 3. Boholano chickens were raised at Ubay Stock Farm, Lomangog, Ubay, Bohol. Experimental animals were raised in a semi-confinement system and maintained under uniform management conditions. Each of six families composed of 5:1 female to male ratio were confined in a 5 square meter area while the other six families with the same female to male ratio in a 10 square meter area. Each pen of 5 and 10 square meter area was situated in an opposite direction. Every family was randomly assigned in each pen in every generation and chickens were randomly assigned in each pen. The records have been collected from 3 generations. Experimental animals were fed twice a day, and vaccinated against Newcastle Disease (NCD). Eggs were collected daily, marked, weighed and stored at room temperature prior to incubation. An egg was left in the nest to urge hen to continue laying. The eggs collected for 7 days were incubated artificially. After hatching, chicks were weighed and brooded for 21 days, hardened from 22 to 45 days old and leg-banded for proper identification. Family selection was employed in the identification of parents of the next generation.

Statistical Analysis

Data analysis on growth and reproductive traits were carried out using the Statistical Analysis System (SAS 9.1) 2001. All percentages were first converted to square root transformation prior to statistical analysis. To estimate variance components, restricted maximum likelihood (REML) of the statistical analysis system was utilized. The number of eggs produced was computed annually. Computations for fertility and hatchability (Desha

et al., 2015) were as follows:

$$Fertility = \frac{No.of\ viable\ eggs}{No.of\ eggs/set} \times 100\%$$

$$Hatchability = \frac{No.of\ hatched\ chicks}{No.of\ eggs/set} \times 100\%$$

RESULTS AND DISCUSSION

Table 1 shows the statistical description (number of records, means and standard deviations) for body weight of Boholano native chicken. Only the significant effects, specifically batch and sex were included in the final model which was used in computing for the variance components.

Table 1. Body weight (g) of Boholano Philippine native chicken.

Trait*	N	Mean	Standard Deviation
BW1	885	28.26	2.26
BW21	885	101.89	26.45
BW45	884	227.12	55.64
BW75	870	430.91	101.09
BW100	836	584.65	126.21
BW120	809	735.96	151.01

*body weight (BW) at different age in days

As expected, chicks recorded increasing body weights as they grew older. The mean body weight of a chick at hatch was 28.26 g. This finding is higher than recorded body weight at hatch of Philippine native chicken (Lambio, 2010) where body weight (g) at day old of Banaba, Bolinao, Camarines and Paraoakan were 26.40, 25.80, 25.25 and 23.96, respectively. However, the obtained value was far from the result of study of Somo (2015) and Abou El-Ghar (2014). In Nigeria, similar study revealed that body weight at hatch of naked neck chicken was 37.22 ± 0.32 (Adeyinka *et al*., 2006). Meanwhile, Valavan *et al.,* (2016) stated that the hatch weight of gramapriya chicken in India was 33.35 ± 0.10, comparable to the result that was reported by Kumar *et al.*, (2014). The mean body weight of Boholano chicken at BW21, BW45, BW75, BW100 and BW120 were 101.89, 227.12, 430.91, 584.65 and 735.96 g respectively. The observed body weights in this research were similar to the report of Kumar *et. al*., (2023). It was observed that Boholano chicken are slow growing bird that attain a kilogram of body weight at the age of 20 weeks or more. However, growth performance can be improved through proper selection and adopting appropriate breeding programs.

Estimates of Heritability

Heritability value determines how genetic factor for a trait is heritable from parent to offspring. The heredity value ranges from 0.00 to 1.00 with categories: $h^2 < 0.10$ is low, h^2: 0.10-0.30 is moderate, and $h^2 > 0.30$ is high (Purwantini *et. al.*, 2021). Table 2 shown the calculated heritability and genetic correlation for growth and reproductive characteristics of Boholano chicken. The estimates of heritability for body weight at various ages ranged from 0.05 to 0.28. The resulted moderate heritability was obtained from BW1, BW21 and BW75 (0.28, 0.19 and 0.18), respectively while low heritability estimates were from BW45 (0.09), BW100 (0.05) and BW120 (0.05). The heritability estimate for egg weight is moderate (0.15) while fertility (0.07) and hatchability (0.03) were low. Moderate heritability indicates that the trait is partly affected by additive genetic factors rather than environment and by selecting heavier birds in a population could upshot the improvement of genetic characteristics. Meanwhile, the low heritability denotes high environmental influence on the trait.

Table 2. Estimated heritability and genetic correlation for growth and reproductive traits of Boholano Philippine native chicken.

	BW1	**BW21**	**BW45**	**BW75**	**BW100**	**BW120**	**EW**	**Fert**	**Hatch**
BW1	**0.28**	0.22	0.26	0.17	0.14	0.10	-0.21	0.01	-0.11
BW21		**0.19**	0.57	0.39	0.27	0.24	0.02	0.01	-0.11
BW45			**0.09**	0.57	0.47	0.42	0.04	-0.01	-0.01
BW75				**0.18**	0.75	0.64	-0.70	-0.01	-0.05
BW100					**0.05**	0.84	-0.38	-0.05	-0.09
BW120						**0.05**	-0.36	0.02	-0.10
EW							**0.15**	-0.56	-0.38
Fert								**0.07**	0.05
Hatch									**0.03**

body weight (BW) at different age in days; EW = egg weight; Fert = fertility and Hatch = hatchability

The calculated value of heritability for body weight obtained from this study was comparable to the results of Manjula *et al.,* (2018) and Yousefin Zonuz *et al*., (2013). However, similar studies by Faruque *et al*., (2013), Rotimi *et al.,* (2016), Udeh, (2017) and Adeyinka *et al.*, (2006) revealed low to moderately high heritability while moderate to high heritability was also reported previously by Gaya *et al*., (2006), Kammong Kun and Leotaragul, (2015), Firozjah *et al*., (2015), Cahyadi *et al.,* (2015), Shad *et al*., (2013) and Oleforuh-Okoleh *et al*., (2012). It should be noted that variability in the estimated heritability in different studies may be associated with differences in the definition of trait, size of the population and the methodologies used for genetic parameters estimation.

The estimated heritability of 0.15 for egg weight (EW) of Boholano chicken was lower than the moderate to moderately high heritability estimates described by Yahaya *et al.,* (2009); Oleforuh-Okoleh, (2011); Firozjah *et al*., (2015); Oleforuh-Okoleh (2011); Oleforuh-Okoleh *et al*., (2012); Shad *et al*., (2013); Alipanah *et al*., (2013) and Nayak *et al.,*

(2015) as cited by Firozjah *et al*., (2015).

The results of REML estimation with family as fixed effect and generation as random effect showed that family has no revelatory influence on fertility and in hatchability of chickens (*p-value=0.69 and 0.1407 respectively*). The estimates on phenotypic variance, heritability, and its standard error for fertility and hatchability is shown in Table 3.

Table 3. Genetic parameter estimates of fertility and hatchability.

Trait	Phenotypic Variance	$h^2 \pm$ s.e.
Fertility	1054.75	0.07 ± 0.07
Hatchability	441.81	0.03 ± 0.03

The calculated low heritability (0.07) for fertility was in range on the previous report of Sapp *et al*., (2004) but much smaller than the reported value from other investigations (Cavero *et al*., 2011 and Abou El-Ghar, 2014). This indicates that genetic variability is already narrow. However, the low value of heritability could be due to the genetic constitution of the breed, differences in the age of hens, poor ability of male to produce viable sperm and other non-genetic factors like nutrition, management and environmental factors.

The estimated value (0.03) of heritability for hatchability trait was low that conformed to what Cavero *et al.,* (2011) stated that hatchability is a common transmissible trait with low heritability. This value was very far from the reported moderately high estimate by Sapp *et al.,* (2004) and Abou El-Ghar, (2014). Results showed that there is a high influence of environmental factors affecting hatchability like breeding hen nutrition, insufficient nutrient content of egg, egg size and weight, quality of egg shell and exposure to other uncontrollable factors hindering the requirement of the developing embryo during incubation.

Genetic Correlation

Correlation analysis of body weights at different ages showed low to high positive correlation ranges from 0.10 to 0.84 compared to moderate to high positive correlation in Thai native chicken (Kammongkun and Leotaragul, 2015). BW100 and BW120 had the highest value of correlation of 0.84 while BW75 and BW100 had value of correlation of 0.75. However, low positive correlation (0.10 and 0.14) was found between BW1 and BW120 and BW1 and BW100, respectively. This indicates that the initial body weight and body weight at 120 days are under different genetic influences. In other words, genes which control the growth of chicks at the start (BW1) and at BW120 are somewhat different. This affirms the finding of Sartika and Noor (2005).

Weak positive correlation indicates very minimal association of two variables while negative correlation indicates that there was no relationship between two variables. In this study, the relationship of body weight at various ages to egg weight, fertility and hatchability ranged from 0.05 to -0.70. Results also showed that there was a very weak correlation (0.05) between fertility and hatchability. Thus, it can be said that hatchability was not affected by fertility. This may be due to many contributing factors. According to King'ori (2011), there are different contributing factors why viable egg fail to hatch such as inadequate nutrient content of the egg, lethal genes and exposure of the egg to some factors that fail the needed

requirement for chick development. Meanwhile, the standard error of estimates was low indicating the sufficient precision and reliability of the estimates.

CONCLUSION

The values of estimated heritability for studied traits were within the range of values obtained in some studies. Growth and reproductive traits are the important characteristics to consider in the native chicken production since these chickens are raise mainly by rural producers for both meat and eggs. Therefore, growth and reproductive traits should be included during selection.

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