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Animal Model Estimation of Genetic Parameters for Most Important Economic Traits in Iranian Native Fowls

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Abstract: (Co)Variance components and genetic parameters for economic traits in Iranian native fowls were estimated using multivariate animal model analysis with DFREML procedure. The data of four stations of native fowls breeding (Mazandaran: 49536, Esfahan: 23108, West Azarbaijan: 24890 and Fars: 30279) was containing records of cocks and hens collected during period of 1988 to 2006. The recorded traits were Body weight (at 8 weeks or 12 weeks), Age at first egg, egg number at 12 first weeks of production and mean egg weight between 28 to 32 weeks. The most estimated heritabilites, except egg number, were more than 0.20. The highest heritabilites for all traits were related to Fars station, whereas most heritabilites in West Azarbaijan were less than other stations. The heritability for egg number was estimated 0.099±0.018 for Esfahan to 0.322±0.012 for Fars. The estimated heritabilities of body weight were medium to high and varied from 0.228±0.014 for Esfahan to 0.548±0.014 for Fars, While, the heritabilities of mean egg weight were high and ranged from 0.223±0.021 for West Azarbaijan to 0.638±0.013 for Fars. The heritability for age at first egg was estimated 0.270±0.021 for Esfahan to 0.520±0.014 for Fars. The most estimated genetic correlations, except between Body weight and Egg weight and between age at first egg and egg weight, were negative. The direct genetic correlations between maturity age and egg number were high and negative, ranging from -0.384±0.033 to -0.987±0.003 for Mazandaran and Fars, respectively.

Key words: Genetic parameters, genetic correlation, heritability, economic traits, native fowls, (co) variance components

INTRODUCTION

In Iran, many native chicken breeds are kept, including Lari, Khazak, Dashtyari, etc. These breeds are assigned as natural monuments of Iran. Iranian indigenous chickens are a meat-cum-egg type. Growth rate and egg production under conventional rearing systems in the villages are very low, also in last several decades imports of exotic breeds have increased risk of extinction. According to these, a national project was planned for their conservation as valuable genetic resources and increase production efficiency of native fowls genetically for economically important traits from 1988. Evidences show that there is good and useful variation in native fowls for different traits, specially for economic ones.

(Co) Variance Components are used to estimation of genetic parameters such as, heritability, genetic and phenotypic correlation in genetic evaluations and understanding these parameters is necessary and useful for designing breeding strategies and evaluating current breeding programs. However, these parameters are a property not only of the trait but also of the population and the environmental conditions surrounding the animals (Falconer and Mackay, 1996).

Nurgiartiningsih *et al.* (2004) estimated the genetic parameters for monthly egg production and egg weight of two lines of white leghorn stored in individual and group cages. The heritabilities for monthly egg production were estimated between 0.04 to 0.44.

The direct heritabilities estimated for body weight at 4, 8, 12 and 16 weeks for a Mexican Chicken by Prado Gonzalez *et al.* (2003) were between 0.07 to 0.21.

The relative economic values of most important traits for native fowls have been estimated by Kiani Manesh *et al.* (2002). The reported heritabilities by Mohammad Abadi (1999) for Fars station were 0.39, 0.36, 0.19, 0.32, 0.40 and 0.41 for body weight at 12 weeks, age at sexual maturity, egg number and egg weight at 28, 30 and 32 week, respectively. Also Zieba and Lukaszewicz (2003) estimated heritabilities of 0.60, 0.18 and 0.53 for body weight, egg number at 15 first weeks and egg weight, respectively.

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The objective of the current study is to estimate genetic parameters for economic traits of Iranian native fowls, so that efficient multi-trait selection programs can be developed which will maximize economic return and secure genetic diversity.

MATERIALS AND METHODS

The data consisted of BW: Body Weight (at 8 weeks for Mazandaran or 12 weeks for other stations), AFE: age at first egg, EN12: egg number laid at 12 first weeks of production and MEW: mean egg weight between 28 to 32 weeks related to four stations (Mazandaran, Fars, West Azarbaijan and Esfahan) collected between 1988 to 2006. The number of observations varied between 6608 to 49150 for each trait and each station summarized in Table 1.

These data were used for estimation of co(variance) components by using derivative free restricted maximum likelihood algorithm (Meyer, 1991) and following four traits animal model:

$$y_i = X_i b_i + Z_i u_i + e_i$$

Where y was the vector of observations in ith trait, b_i was the vector of fixed effects (b1 for BW included generation, hatch and sex, b2 for EN12 included generation, hatch and days in production (DP) as covariate and b3 and b4 for AFE and MEW included generation and hatch), u_i was the vector of random additive genetic effects of animals, e_i was the vector of random residual effects and X and Z were incidence matrices relating fixed and random effects to the records, respectively. Also expectations and (co)variance matrices were:

$$E(y_i) = X_i b_i \qquad E(u_i) = 0 \qquad E(e_i) = 0$$

$$Cov(y_i, y_j) = Z_i A Z_j' \, \delta 2g + I \, \delta 2e$$

$$Var(u) = A \otimes G \qquad Var(e) = I \otimes R \qquad Cov(u, e) = 0$$

Table 1: No. of records, means and standard deviations for traits collected from four stations

Station	Trait	No. of records	Mean g day No.	Standard deviation g day No.	Coefficient variation (%)
Mazandaran	BW	49150	526.48	125.98	23.92
	ASM	35461	160.54	17.96	11.19
	EN	35965	38.54	16.89	43.82
	EW	35663	47.27	4.46	9.44
Fars	BW	28701	840.32	185.23	22.04
	ASM	23816	166.64	18.84	11.03
	EN	23851	53.02	17.24	32.53
	EW	23242	43.87	3.21	7.31
Esfahan	BW	22781	1284.57	215.13	16.74
	ASM	12060	178.55	21.07	11.80
	EN	12091	37.20	16.01	43.03
	EW	11696	47.88	3.46	7.63
Azarbaijan	BW	24890	1329.48	222.71	16.75
	ASM	6608	184.77	18.57	10.04
	EN	6472	35.40	13.82	39.05
	EW	8314	51.16	4.12	8.13

$$G = \begin{bmatrix} \sigma^2_{B1} & \sigma_{B12} & \sigma_{B13} & \sigma_{B14} \\ \sigma_{B21} & \sigma^2_{B21} & \sigma_{B23} & \sigma_{B24} \\ \sigma_{B31} & \sigma_{B32} & \sigma^2_{B3} & \sigma_{B34} \\ \sigma_{B41} & \sigma_{B42} & \sigma_{B43} & \sigma^2_{B44} \end{bmatrix} \quad R = \begin{bmatrix} \sigma^2_{e1} & \sigma_{e12} & \sigma_{e13} & \sigma_{e14} \\ \sigma_{e21} & \sigma^2_{e21} & \sigma_{e23} & \sigma_{e24} \\ \sigma_{e31} & \sigma_{e32} & \sigma^2_{e3} & \sigma_{e34} \\ \sigma_{e41} & \sigma_{e42} & \sigma_{e43} & \sigma^2_{e44} \end{bmatrix}$$

Where A is the additive relationship matrices between birds and G and R are positive definitive genetic and residual Co (variance) matrices.

RESULTS AND DISCUSSION

Results showed that most heritabilites estimated, except EN12 (ranged between 0.099 and 0.185) were more than 0.20 (Table 2). The highest estimated heritabilites for all traits were related to Fars station, whereas most heritabilites in West Azarbaijan was less than other stations that was agree with Nejati-Javaremi *et al.* (2002). The estimated heritabilities of BW were medium to high and varied from 0.228±0.014 for Esfahan to 0.548±0.014 for Fars, whereas, its values for MEW were higher and ranged from 0.223±0.021 to 0.638±0.013 for West Azarbaijan and Fars, respectively. The heritability for AFE was estimated 0.270±0.021 for Esfahan to 0.520±0.014 for Fars. The heritability for EN12 was estimated 0.158±0.009, 0.322±0.012, 0.099±0.018 and 0.185±0.019 for Mazandaran, Fars, West Azarbaijan and Esfahan, respectively. Nikbin (1998) used records of Fars station and reported heritability estimates of 0.37, 0.35, 0.18 and 0.38 for body weight, age at sexual maturity, egg number and egg weight, respectively. Also the estimated heritabilities reported by Francesch *et al.* (1997) for egg number and egg weight were, 0.20 and 0.59, respectively.

The most estimated genetic correlations except between BW and EW and between AFE and EW was negative agreed in sign with those reported by several, for example Sabri *et al.* (1999) and Ziêba and Lukaszewicz (2003).

The genetic correlation between BW and EN12 except Fars (0.172±0.027) was negative (-0.111±0.087 to -0.225±0.061). AFE has medium to high negative correlation with EN12 ranging from -0.384±0.033 to -0.987±0.003 for Mazandaran and Fars, respectively.

Generally Results show that the different estimated parameters is caused by different genetic and population

Table 2: The estimated Heritabilites±standard errors for BW: Body weight (at 8 weeks for Mazandaran or 12 weeks for other stations), AFE: Age at first egg, EN12: egg number at 12 first weeks of production and MEW: mean egg weight between 28 to 32 weeks for Iranian Native Fowls stations

Trait	Mazandaran	Fars	Azarbaijan	Esfahan
BW	0.279±0.009	0.548±0.014	0.254±0.014	0.228±0.014
AFE	0.346±0.012	0.520±0.014	0.276±0.027	0.270±0.021
EN12	0.158±0.009	0.322±0.012	0.099±0.018	0.185±0.019
MEW	0.458±0.012	0.638±0.014	0.223±0.021	0.246±0.022

structure of birds in each station such as number of birds, number of generations and initial potential of each breed at the beginning of project.

Between traits the highest ratio of genetic variation (h^2) is related to MEW and between stations Fars has more value in comparison with other stations.

Nevertheless results show that MEW has positive genetic correlation with BW for all stations that is; we can indirectly select hens with heavier egg weights by selecting the heavier ones at initial weeks.

Also results show that there is a medium to high negative correlation between AFE with EN12 and low correlation with other traits. This indicates that we can have lower cost of production by lowering this trait and increasing egg production without significant diverse effect on body weight and egg weight. On the other hand the negative genetic correlation between MEW and AFE show that by selecting the birds with more potential for each trait the second traits decreases and reversely (Table 3 and 4).

Also, Results of this study show that there are very good closeness between estimated genetic parameters here and reported ones by others, with the exception of egg number of Fars station that is higher than other studies. These results show that there is sufficient variation for most important traits in Iranian native fowls and parameters estimated here may be used along with economic indices of the four traits to optimize breeding programs for birds of these stations using a stochastic simulation model.

Table 3: The estimated Additive genetic correlations±standard errors for BW: Body weight (at 8 weeks for Mazandaran or 12 weeks for other stations), AFE: Age at first egg, EN12: egg number at 12 first weeks of production and MEW: mean egg weight between 28 to 32 weeks for Iranian Native Fowls stations

Correlated traits		Mazandaran	Fars	Azarbaijan	Esfahan
BW	AFE	-0.104±0.029	-0.116±0.026	-0.047±0.012	-0.039±0.014
	EN12	-0.143±0.037	0.172±0.027	-0.111±0.087	-0.225±0.061
	MEW	0.417±0.024	0.518±0.018	0.184±0.058	0.294±0.054
AFE	EN12	-0.384±0.033	-0.987±0.003	-0.748±0.069	-0.675±0.037
	MEW	0.210±0.026	0.085±0.023	0.137±0.075	0.251±0.061
EN12	MEW	-0.264±0.033	-0.186±0.025	-0.199±0.101	-0.470±0.066

Table 4: The estimated residual correlations±standard errors for BW: Body weight (at 8 weeks for Mazandaran or 12 weeks for other stations), AFE: Age at first egg, EN12: egg number at 12 first weeks of production and MEW: mean egg weight between 28 to 32 weeks for Iranian Native Fowls stations

Correlated traits		Mazandaran	Fars	Azarbaijan	Esfahan
BW	AFE	-0.184±0.009	-0.211±0.018	-0.121±0.022	-0.094±0.017
	EN12	0.034±0.009	0.107±0.015	0.036±0.018	0.069±0.016
	MEW	0.057±0.011	0.139±0.020	0.051±0.017	-0.031±0.017
AFE	EN12	-0.133±0.009	-0.508±0.009	-0.309±0.019	-0.600±0.011
EN12	MEW	0.065±0.012	0.156±0.019	0.182±0.021	0.089±0.019
	MEW	0.020±0.010	-0.026±0.016	-0.042±0.018	0.011±0.008

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