JAPSC

Journal of Animal and Poultry Sciences, 2015, 4 (2): 20-26

Available online at http://www.JAPSC.com

Estimation of genetic parameters for economic traits in Mazandaran native chickens

N. Gorgani Firozjah[1], H. Atashi[1*], and A. Zare[2]

[1]*Department of Animal Science, Shiraz University, Shiraz, IRAN*

[2] *Native chicken breeding station of Mazandaran, Sari, IRAN*

Abstract

The aims of this study were to estimate genetic parameters and genetic trends of economic traits in Iranian native chickens. The used data were collected from the Mazandaran native chickens breeding center located in Mazandaran Province during 1988 and 2011 years. The (co)variance components were estimated through an animal model using Gibbs sampling method. The estimated heritability (±SE) for body weight at hatch (BW1), body weight at age of 8 (BW8) and 12 (BW12) weeks, age at sexual maturity (ASM), body weight at sexual maturity (WSM), the number of produced eggs during the first 12 weeks of production (ENs), the first egg weight (FEW), average egg weight at age of 28 (EW28), 30 (EW30), and 32 (EW32) weeks of production, and average egg weight of 28 to 32 weeks of production (EW28-32) were 0.33(±0.02), 0.29(±0.02), 0.28(±0.02), 0.39(±0.02), 0.47(±0.02), 0.24(±0.02), 0.20(±0.02), 0.34(±0.02), 0.39(±0.02), 0.40(±0.01) and 0.51(±0.02), respectively. The average inbreeding coefficient was 2.8%, and ranged from zero to 29.8%. The results revealed significant effect of inbreeding on the BW1, BW8, ASM, ENs and EW28-32. The estimated genetic trends for BW8, BW12, WSM, FEW, EW28, EW30, EW32, ENs and EW28-32 were significant.

Key words: Heritability, Genetic trend, Genetic parameters, Mazandaran native chickens

*****Corresponding author: Tel: +98 9176570837; Fax: +98 71 32286073

E-mail address: atashi@shirazu.ac.ir

Introduction

Indigenous chickens comprise about 80% of the national flocks in Africa and Asia, and could form the basis for genetic improvement and diversification to produce breeds adapted to local conditions (Hoffmann, 2005), but unfortunately, about 50% of the chicken breeds are classified as being at risk. Despite their low growth rates and egg production, indigenous chickens are more resistant to various diseases, and can survive under harsh nutritional and environmental conditions (Minga et al., 2004). Iranian indigenous chickens are meat-egg type or dual-purpose, but compared to commercial breeds, are generally poor producers of eggs and meat. Although, the maintenance of genetic resources of each country counts as maintaining national wealth, during the past several decades importation of exotic breeds have increased risk of extinction Iranian native chickens (Ghazikhani-Shad et al., 2007). The initial endeavor for breeding and extension of Iranian native chickens started back in 1984 with establishing six breeding stations in different regions of Iran (Mazandaran, Fars, Esfahan, West Azarbaijan, Yazd, and Khorasan). Native chicken breeding station of Mazandaran located in the North of Iran debuted in 1988 with two main objectives, extension and genetic improvement. In this station, genetic improvement is done by selecting the best 100 roosters and 800 hens as parents of the next generations, and then 8-week old chicks get distributed among rural communities with the aim of increasing the population of native chickens in Northern provinces of Iran (Enayati and Rahimi, 2009). Mazandaran is one of the most densely populated provinces in Iran, is located on the southern coast of the Caspian Sea, and enjoys a moderate, subtropical climate with an average temperature of 25 °C in summer and about 8 °C in winter. Winters are cool and rainy while summers are hot and humid. Although there is much evidence that local chicken production plays an important role in the lives of rural households, a very few work has been done in terms of improving the productivity of local chickens. Improvement in the productivity of indigenous breeds requires attention to nutritional, breeding, health, and management aspects (Norrisand Ngambi, 2006). From the breeding point of view, genetic improvement through selection within local chickens seems to be an attractive option (Lwelamira et al., 2009). Although, evaluation of implemented breeding programs through estimation of genetic progress and inbreeding coefficient is useful to develop better breeding programs for future, there are a very few studies carried out to investigate the efficiency of genetic selection done for Iranian native chickens. The aims of this study were to estimate genetic parameters and genetic trends of selected economic traits in native chicken in Mazandaran.

Materials and Methods

The history of the Mazandaran native chickens breeding center traces back to 1986, when, about 5,000 males and females were purchased from rural regions across the Mazandaran province and kept in a quarantine farm for one year. Then about 2,500 birds of both sexes were kept to produce hatching eggs and chicks produced from these eggs were transferred to the station in 1988 (Niknafs et al., 2012). Genetic evaluation of the birds for body weight at 8 weeks, age of the hens at first egg, average egg weight, and total number of eggs laid during first 12 weeks after flocks maturity (when 5% of the flockare in egg production) have been performed. Economic indexes are calculated for these traits and birds of both sexes are selected based on their aggregate genotypes for these traits (Khadem et al., 2010). Parents of each generation (100 cocks and 800 hens) are selected among 6,000 pedigreed and performance-recorded birds produced each generation (Enayati and Rahimi, 2009). The main ingredients of the ration consisted of corn, soybean meal, barley and sometimes wheat, shellfish, dicalcium phosphate, salt, methionine, lysine, mineral and vitamins supplements (Niknafs et al., 2012).

Data and pedigree files

The used data were collected by the Mazandaran native chickens breeding centers (Mazandaran, Iran), during 1988 and 2011. The data file consisted of two registered fixed effect factors (generation and sex), and 11 recorded traits including body weight at hatch (BW1), body weight at age of 8 (BW8) and 12 (BW12) weeks, age at sexual maturity (ASM), body weight at sexual maturity (WSM), the number of produced eggs during the first 12 weeks of production (ENs), the first egg weight (FEW), average egg weight at age of 28 (EW28), 30 (EW30), and 32 (EW32) weeks of production, and average egg weight of 28 to 32 weeks of production (EW28-32). BW1, BW8, and BW12 have been measured in both males and females. The pedigree file included of 12,173 roosters and 53,883 hens of about 20 generations.

Statistical analysis

In this study, several linear mixed models were used through MIXED procedure in SAS statistical analysis method (SAS Institute, 1999). In the models, inbreeding coefficient was considered as a covariate with other factors such as generation and gender, random effect of the animal, covariate effect of body weight (for some of the traits). The (co)variance components were estimated using TM program (available on request from the author via andres.legarra@toulouse.inra.fr), using a Bayesian analysis, and performing numerical integration through the Gibbs sampling. Afterwards, single-trait analyses were carried out; and the estimates served to build up the genetic and residual (co)variance matrices used as initial values for estimation of variance components in a multi-trait analysis.

Results and Discussion

Table 1 presents number of recorded animals for body weight and egg production, and the descriptive statistics of the characteristics measured in the Mazandaran native chickens breeding centers. Trait of ENs showed the highest phenotypic variation with coefficient of variation 35.3% and EW32 showed the lowest phenotypic variation with a coefficient of variation 7.5% (Table 1).

Table 1. Number of observations (N), mean, standard deviation (SD), coefficient of variation (CV %), minimum and maximum values of the recorded traits[1].

Traits	N	Mean	SD	CV (%)	Minimum	Maximum
BW1(g)	15601	35	3.1	8.8	24.8	53.2
BW8(g)	15601	678	180.4	26.6	200	1350
BW12(g)	15477	1055	279.8	26.5	220	2020
ASM (d)	11975	161	21.2	13.2	120	239
WSM(g)	12026	1778	218.1	12.3	720	2940
ENs	11552	41	14.4	35.1	10	97
FEW(g)	10187	42	6.5	15.5	30	70.9
EW28(g)	10854	48	4.2	8.7	30.1	70.5
EW30(g)	11161	49	4.0	8.2	32.9	69.7
EW32(g)	11270	51	3.8	7.5	32.5	70.5
EW28-32(g)	11737	49	3.5	7.1	30.3	69.8

[1]BW1: body weight at hatch, BW8: body weight at age of 8 weeks, BW12: body weight at age of 12 weeks, ASM : age at sexual maturity, WSM: body weight at sexual maturity, ENs: the number of produced eggs during the first 12 weeks of production, FEW: the first egg weight, EW28: average egg weight at age of 28 weeks, EW30: average egg weight at age of 30 weeks, EW32: average egg weight at age of 32 weeks, EW28-32: and average egg weight of 28 to 32 weeks.

The mean hatch weight (BW1) of Mazandaran native chicken was about 35 (standard deviation= 3.1) grams, which increased to 1055 grams at 12 weeks of age (Table 1). Yousefi-Zonuz et al. (2013) reported the mean hatch weight of Esfahan native chickens was about 37.75 grams, which increased to 1461.37 grams at 12 weeks of age. Hens attained sexual maturity at an average of 161 (standard deviation =21.2) days and an average weight of 1778 (standard deviation =218.2) grams (Table 1). The average first egg weight was 42 (standard deviation = 6.5) grams, and the average number of produced eggs during the first 12 weeks of production was estimated to be 41 (standard deviation =14.4) eggs. Wolc et al. (2012) reported that average egg weight during 120 days of production was 57.66 (standard deviation=4.86) grams, and average of age sexual maturity was 154.96 (standard deviation=9.14) days in layer chickens. The averages of ASM, EN, BW12 and EW28-32 in Fars native chickens (Fars Province, Iran) were reported to be 166.6 days, 53 eggs, 840.3 grams and 43.8 grams, respectively (Ghazikhani-Shad et al., 2013). Dana et al. (2011) reported that the averages of hatch weight, body weight at 16 weeks of age, and average age at sexual maturity in Horro chickens of Ethiopia were 25 grams, 621 grams and 190 days, respectively. Sang et al. (2006) reported that average age at first egg, average egg weight at first egg, average number of eggs laid by age of 270 days, and average egg weight produced during 270 days of production in five Korean native chickens ranged 147.36 to 152.84 days, 30.64 to 33.24 grams, 84.49 to 89.75 eggs, and 47.90 to 50.76 grams, respectively.

Average inbreeding coefficient was 2.8% (with a minimum of zero and a maximum of 29.8%), 77% of the birds (81% of the roosters and 11% of the hens) were inbred and the average inbreeding coefficient in inbred birds was 3.6%. Ghazikhani-Shad et al. (2013) reported that the average inbreeding coefficient in the Fars native chickens (generations 1 to 15) was 0.002%, 41% of the birds were inbred and the mean inbreeding coefficient in inbred birds was 0.019%. Bahmanimehr et al. (2012) reported that the average inbreeding coefficient in the Fars native chickens (generations of 7 to 11) was 0.0096, 34.5% of the birds were inbred and the average inbreeding coefficient in inbred birds was 0.28%. The pedigree files used by Bahmanimehr et al. (2012) and Ghazikhani-Shad et al. (2013) were not complete, resulted to estimate low inbreeding level. In the present study, the complete pedigree file was used and the estimated inbreeding level is accurate. The results of regression analyses showed that inbreeding increased BW1 (5.55 (1.34) grams), and ASM (37.18 (7.68) days), decreased BW8 (232 (47.2) gram), ENs (36.05 (6.46) eggs), and EW28-32 (4.05 (1.64) grams), but showed no significant effect on the BW12, WSM, FEW, EW28, EW30, and EW32 ($P \geq 0.05$). Sewalem et al. (2010) reported that inbreeding reduced the number of eggs and delaying sexual maturity in White Leghorn hens.

The estimated genetic parameters for body weight and egg production are shown in tables 2 to 4. The estimated heritability for body weight at different ages varied from 0.28 (BW12) to 0.33 (BW1) (Table 2). Dana et al. (2011) reported that heritability for body weight at different ages in Horro chicken of Ethiopia varied between 0.15 (body weight at age of 6 weeks) to 0.40 (body weight at hatch). The estimated heritability for egg weight at different time of production are presented in table 3 and varied from 0.20 (FEW) to 0.51 (EW28-32). Shadparvar and Enayati (2012) reported that the heritability for FEW and EW28-32 in Mazandaran native chicken were 0.12 and 0.24, respectively. The estimated heritability for EW in three breeds of Catalan poultry was ranged from 0.48 to 0.59 (Francesch et al., 1997). The estimated heritability for ENs was 0.24 (Table 4), which is lower than 0.40 which reported by Kamali et al. (2007) in Fars native chickens. Dana et al. (2011) reported that heritability for egg numbers during early part laying period in Horro chickens varied between 0.20 (egg numbers in the second month of production) to 0.56 (egg numbers in the third month of production). The heritability estimates for ENs in three breeds of Catalan poultry were ranged from 0.20 to 0.33 (Francesch et al., 1997). The estimated heritability for ASM and WSM was 0.39 (0.02) and 0.47 (0.02), respectively (Table 4). Shadparvar and Enayati (2012) reported that the heritability for ASM and WSM in Mazandaran native chickens were 0.34 and 0.24, respectively. Sang et al. (2006) reported that heritability for age at first egg, body weight at first egg, egg weight at first egg, and the number of eggs laid by age of 270 days, in five Korean native chickens ranged from 0.12 to 0.32, 0.39 to 0.57, 0.06 to 0.13, 0.24 to 0.37, respectively.

Table 2. Heritability (diagonal), genetic (above diagonal) and environmental (below diagonal) correlations for body weight[1]

Traits	BW1	BW8	BW12
BW1	0.33(±0.02)	0.35(±0.04)	0.32(±0.04)
BW8	-0.04(±0.01)	0.29(±0.02)	0.94(±0.01)
BW12	-0.03(±0.01)	0.57(±0.01)	0.28(±0.02)

[1]BW1: body weight at hatch, BW8: body weight at age of 8 weeks, BW12: and body weight at age of 12 weeks.

Table 3. Heritability (diagonal), genetic (above diagonal) and environmental (below diagonal) correlations for the egg production traits[1]

Traits	FEW	EW28	EW30	EW32	EW28-32
FEW	0.20(±0.02)	0.83(±0.03)	0.83(±0.03)	0.83(±0.04)	0.83(±0.03)
EW28	0.13(±0.02)	0.34(±0.02)	0.97(±0.01)	0.96(±0.01)	0.99(±0.01)
EW30	0.09(±0.02)	0.35(±0.01)	0.39(±0.02)	0.98(±0.01)	0.99(±0.01)
EW32	0.08(±0.02)	0.33(±0.02)	0.36(±0.02)	0.40(±0.01)	0.99(±0.01)
EW28-32	0.12(±0.02)	0.75(±0.01)	0.75(±0.01)	0.71(±0.01)	0.51(±0.02)

[1]FEW: the first egg weight, EW28: average egg weight at age of 28 weeks, EW30: average egg weight at age of 30 weeks, EW32: average egg weight at age of 32 weeks, EW28-32: and average egg weight of 28 to 32 weeks.

Table 4. Heritability (diagonal), genetic (above diagonal) and environmental (below diagonal) correlations for the BW12, ASM, ENs, EW28-32 and WSM[1]

Traits	BW12	ASM	ENs	EW28-32	WSM
BW12	0.28(±0.02)	0.05(±0.05)	-0.16(±0.06)	0.45(±0.04)	0.71(±0.03)
ASM	-0.18(±0.02)	0.39(±0.02)	-0.85(±0.03)	0.32(±0.04)	0.63(±0.03)
ENs	0.03(±0.02)	-0.51(±0.01)	0.24(±0.02)	-0.35(±0.05)	-0.66(±0.04)
EW28-32	0.09(±0.02)	0.08(±0.02)	-0.09(±0.02)	0.51(±0.02)	0.58(±0.03)
WSM	0.11(±0.02)	0.46(±0.02)	-0.16(±0.02)	0.16(±0.02)	0.47(±0.02)

[1]BW12: body weight at age of 12 weeks, ASM: age at sexual maturity, ENs: the number of produced eggs during the first 12 weeks of production, EW28-32: average egg weight of 28 to 32 weeks, and WSM: body weight at sexual maturity.

The estimated genetic correlations between body weight at different ages are presented in table 2 and varied from 0.32 (BW1 and BW12) to 0.94 (BW8 and BW12). Shadparvar and Enayati (2012) reported that the genetic correlations between body weights at different ages varied from 0.04 (BW1 and BW12) to 0.46 (BW1 and BW8). Sang et al. (2006) reported that genetic correlation between body weight at first egg, and body weight at age of 270 days in five Korean native chickens ranged from 0.84 to 0.97. Silva et al. (2013) reported that genetic correlations between body weights at different ages are high, except for weight at hatch, which, in general, presents lower correlations with the other measures of body weight in two quail strains. The estimated genetic correlations between egg weights at different time of production are presented in table 3 and varied from 0.83 to 0.93. The estimated genetic correlation between WSM and ASM was 0.63, means that hens with high weight have later sexual maturity. Yousefi-Zonuz et al. (2013) reported that genetic correlation between ASM and WSM in Esfahan native chickens (Esfahan province, Iran) was 0.15. The estimated genetic correlation between the number of produced eggs during the first 12 weeks of production (ENs) with age at sexual maturity (ASM) and weight at sexual maturity (WSM) were -0.85 and -0.66, respectively, implies that hens with later sexual maturity and hens with higher weight at sexual maturity would produce fewer eggs. The estimated genetic correlation between ASM (age at sexual maturity) and EW28-32 was 0.32 (standard error=0.04) implies that hens with later sexual maturity would produce heavier eggs. Wolc et al. (2012) reported that genetic correlation between age at first egg and egg weight in layer chickens was 0.24. There was a negative genetic correlation between the number of produced eggs and average egg weight of 28 to 32 weeks, implies that hens which produce more eggs, would produce eggs with lower weight which is in agreement with previous studies (Lubritzand Smith, 1996; Niknafs et al., 2012). The estimated genetic trends for BW8, BW12, WSM, FEW, EW28, EW30, EW32, EW84, ENs and EW28-32 were significant ($P< 0.05$).

Acknowledgments

We sincerely thank the farm attendants who worked on data collection at the breeding station of Mazandaran native chicken.

References

Bahmanimehr, A., G. Eskandari, and M. Pakizeh. 2012. Estimation of Genetic Parameters and inbreeding effects of Economic traits in native chicken under short term selection. *Life Science Journal*, 9:1635-1638.

Dana, N., E. Vander Waaij, and J. Van Arendonk. 2011. Genetic and phenotypic parameter estimates for body weight and egg production in Horro chicken of Ethiopia. *Tropical Animal Health and Production*, 43:21-28.

Enayati, B., and G. Rahimi. 2009. Genomic growth hormone, growth hormone receptor and transforming growth factor β-3 gene polymorphism in breeder hens of Mazandaran native fowls. *African Journal of Biotechnology*, 8:3154–3159.

Francesch, A., J. Estany, L. Alfonso, and M. Igelesias. 1997. Genetic parameters for egg number, egg weight, and egg shell color in three Catalan poultry breeds. *Poultry Science*, 76:1627-1631.

Ghazikhani-Shad, A., A. Mansourizalani, and J. Nasr. 2013. Estimation of genetic parameters, inbreeding trend and its effects on production traits of native fowls in Fars province. *Journal of Biological Sciences*, 16:598-600.

Ghazikhani-Shad, A., A. Nejati Javarami, and H. Mehrabani Yeganeh. 2007. Animal model estimation of genetic parameters for most important economic traits in Iranian native fowls. *Pakistan Journal of Biological Science*, 10:2787-2789.

Hoffmann, I., 2005. Research and investment in poultry genetic resources-challenges and option for sustainable use. *World's Poultry Science Journal*, 61:57–70.

Kamali, M. A., Sh. Ghorbani, M. Moradi-Sharbabak, and M. J. Zamiri. 2007. Heritability's and genetic correlation of economic traits in Iranian native fowl and estimated genetic trend and inbreeding coefficients. *British Poultry Science*, 48:443- 448.

Khadem, A., H. Hafezian, and G. Rahimi-Mianji. 2010. Associationof single nucleotide polymorphisms in IGFI, IGF-II and IGFBP-II with production traits in breeder hens of Mazandaran native fowls breeding station. *African Journal of Biotechnology*, 9:805–810.

Lubritz, D. L., and L. Smith. 1996. Genetic parameter estimates for egg production in dwarf broiler breeders. *Journal of Applied Poultry Research*, 5:305-310.

Lwelamira, J., G. Kifaro, and P. Gwakisa. 2009. Genetic parameters for body weights, egg traits and antibody response against New castle Disease Virus (NDV) vaccine among two Tanzania chicken ecotypes. *Tropical Animal Health and Production*, 41:51–59.

Minga, U., P. L. Msoffe, and P. S. Gwakisa. 2004. Biodiversity (variation) in disease resistance and in pathogens within rural chicken. *World Poultry Congress, Istanbul, Turkey*.

Niknafs, S., A. Nejati Javaremi, H. Mehrabani Yeganeh, and S. A. Fatemi. 2012. Estimation of genetic parameters for body weight and egg production traits in Mazandaran native chicken. *Tropical Animal Health and Production*, 44:1437-1443.

Norris, D., and J. Ngambi. 2006. Genetic parameter estimates for body weight in local Venda chickens. *Tropical Animal Health and Production*, 38:605–609.

SAS Institute. 1999. SAS/STAT User's Guide. Version 8 ed. SAS Institute Inc., Cary, NC.

Sang, B. D., H. S. Kong, H. K. Kim, C. H. Cho, D. Kim, Y. M. Cho, B. C. Sang, J. H. Lee, G. J. Jeon, and H. K. Lee. 2006. Estimation of genetic parameters for economic traits in Korean native chickens. *Asian-Australasian Journal of Animal Sciences*, 19:319–323.

Sewalem, A., K. Johansson, M. Wilhelmson, and K. Lillpers. 2010. Inbreeding and inbreeding depression on reproduction and production traits of White Leghorn lines selected for egg production traits. *British Poultry Science*, 40:203-208.

Shadparvar, A. A., and B. Enayati. 2012. Genetic parameters for body weight and laying traits in Mazandaran native breeder hens. *Iranian Journal of Applied Animal Science*, 2:251-256.

Silva, L. P., J. C. Ribeiro, A. C. Crispim, Silva, F. G. C. M. Bonafe´, F. F. Silva, and R. A. Torres. 2013. Genetic parameters of body weight and egg traits in meat-type quail. *Livestock Science*, 153:27-32.

Wolc, A., J. Arango, P. Settar, N. P. V. E. O'Sullivan, Olori, I. M. S. White, W. G. Hill, and J. C. M. Dekkers. 2012. Genetic parameters of egg defects and egg quality in layer chickens. *Poultry Science*, 91:1292-1298

Yousefi-Zonuz, A., S. Alijani, H. Mohammadi, A. Rafat, and H. Daghigh Kia. 2013. Estimation of genetic parameters for productive and reproductive traits in Esfahan native chickens. *Journal of Livestock Science and Technologies*, 1:34-38.