



Inheritance of juvenile traits and immune competence in Gramapriya male line chicken

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Key words: Body weights, Immune competence, Rural poultry, Shank length

Gramapriya male line was evolved from a synthetic population developed by Directorate of Poultry Research, Hyderabad and the population is under selective breeding program for longer shanks at 6 weeks of age for last 4 generations. Rural chicken lines were selected for improved body weight and shank length (Padhi *et al.* 2015 and Rajkumar *et al.* 2012a) with an aim to improve the performance in terminal crosses. The population is a new line and the studies on genetic and phenotypic parameters are limited. Therefore, the present study was carried out on the evaluation of juvenile and immune competence traits in Gramapriya male line.

Gramapriya male line is used as a male line for production of Gramapriya. A total of 2,801 chicks produced from 50 sires and 250 dams in pedigreed full sib mating in three hatches during fourth generation were utilized for the present study. Chicks were reared in deep litter system up to 10 weeks of age. The reproductive parameters, fertility and hatchability were estimated. Growth traits such as 0 day, 2nd, 4th and 6th week body weights and confirmation trait, shank length at 4 and 6 weeks of age were measured.

Immune competence traits

SRBC: First hatch birds (40: 20 of each sex) of were injected intravenously with 0.1ml of 0.5% suspension of packed sheep red blood cells (SRBC) in normal saline at 6 weeks of age and the antibody titres were measured on the fifth day. The total antibody titre was determined by haemagglutination test (Siegel and Gross 1980) and expressed in log₂ values (Wegmann and Smith 1966).

NDV: Chicks (40: 20 of each sex) were vaccinated against ND by ocular route on 7th and 28th day of age with *Lasota* strain. Antibody titre against NDV was determined by haemagglutination inhibition assay (HI) using 4 HA units of NDV. The highest dilution where complete inhibition of agglutination occurred was recorded and expressed in log₂

values (Thayer and Beard 1998).

PHA-P: Birds (40: 20 of each sex) were injected with 0.1 mg of PHA-P dissolved in 0.1 ml phosphate buffer saline intra-dermally into the left wattle of the birds. The pre and 24 h post - injection wattle thickness was measured in mm using a constant tension gauge (Mitutoyo, Japan) as described by Corrier and De Loach (1990) and the difference in swelling was recorded as response to PHA-P solution.

Statistical analysis: Data were analyzed using least squares technique (Harvey 1990) to know the effect of hatch on the traits studied. Significant differences between means were tested by using Duncan's Multiple Range Test (Duncan 1955). Data were corrected for significant hatch effects and then utilized for estimating heritability by variance components analysis (King and Henderson 1954). Genetic and phenotypic correlations were estimated from variance-covariance component analysis (Becker 1975).

Fertility and hatchability: The mean fertility ranged from 88.07 to 90.75% with an overall mean of 89.56. The overall hatchability in this male line was 78.83 and 88.02% on total eggs set (TES) and fertile eggs set (FES), respectively. Rajkumar *et al.* (2012a) recorded similar fertility and higher and slightly lower hatchability was observed on TES and FES, respectively, in Gramapriya male line. Lower per cent hatchability was also reported among other improved varieties such as CARI Shyama and CARI Nirbheek (Malik *et al.* 2009, 2010) and in native breeds such as Kadaknath (Bhardwaj *et al.* 2006) and Aseel (Haunshi *et al.* 2012).

Growth parameters: Highly significant ($P \leq 0.01$) differences among the 3 hatches were observed for body weights and shank length (Table 1). The average least squares means for body weights at day-old, 2, 4 and 6 weeks of age were 37.53±0.06, 136.30±0.42, 300.67±1.21 and 593.46±2.26 g, respectively. The mean body weights obtained in the present study were similar to the reports of Bhardwaj *et al.* (2006), Padhi *et al.* (2012a) and Padhi *et al.* (2012b). However, lower values were also reported by Chatterjee *et al.* (2007), Haunshi *et al.* (2009, 2012) in native breeds while Rajkumar *et al.* (2010a) recorded higher values than the present study in Naked neck birds.

The least squares means of shank length at 4 and 6 weeks of age were 55.78±0.09 and 74.43±0.11mm, respectively, which are slightly lower than the findings of Rajkumar *et*

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al. (2012a) in Gramapriya male line. However, longer shanks were also reported by Padhi *et al.* (2015) in Vanaraja male line, Mallik *et al.* (2003) in synthetic broiler and by Rajkumar *et al.* (2010a) in Naked neck genotypes.

Heritability: Heritability estimates for juvenile body weights were moderate to high except for day old age (0.02 ± 0.09) and ranged from 0.24 ± 0.07 to 0.86 ± 0.13 (Table 1). High heritability estimates of 6 week weight (0.30 to 0.38) hints at possibility of improving body weight by selecting for higher 6 week body weight. The heritability (sire component) estimates in the present study gradually increased from day-old to 6 weeks body weight as was also observed by Rajkumar *et al.* (2010a, b). On the contrary, there was a gradual decrease of dam component with age. Rao *et al.* (2004), Rajkumar *et al.* (2010a) and Haunshi *et al.* (2012) also reported a gradual reduction of maternal effects as age advances. The h^2 from sire components gradually increased from day-old body weight to 6 weeks body weight. The heritability estimates for body weight at early age from dam component were higher than the sire component (Table 1) which indicated the importance of maternal effects in expression of juvenile body weights at early stage of life. As the age advances the heritability from

sire component gradually increased and dam components decreased indicating the gradual reduction of maternal effects. At this age the sex linked effects and additive genetic effects plays a major role in expression of the different traits like body weights and shank length (Rajkumar *et al.* 2010a).

For shank length at 4 weeks of age, heritability estimate from dam component of variance (0.21 ± 0.05) was greater than that estimated from sire component (0.14 ± 0.05) and S+D component (0.17 ± 0.05) indicating the importance of maternal effect for this trait. The results obtained in the present study are comparable with the findings of Rao *et al.* (2004) and Haunshi *et al.* (2012). However, higher estimates were reported by Mallik *et al.* (2003) and Rajkumar *et al.* (2010a).

Genetic and phenotypic correlations: Correlations between juvenile body weights at different ages were high in magnitude and positive in direction (Table 2). The correlation estimates varied from 0.95 to 0.98. The sire component increased in magnitude from day old to 6 weeks while the other components of variance decreased. Genetic and phenotypic correlations among juvenile body weights ranged from 0.23 to 0.98 and 0.10 to 0.78. Correlations between 4 and 6 weeks of age were high in magnitude

Table 1. Least squares means and heritability estimates for body weight and shank length in GML chicken

	BW0	BW2	BW4	BW6	SL4	SL6
Body weight, g						
Least squares means	37.53±0.06	136.30±0.42	300.67±1.21	593.46±2.26	55.78±0.09	74.43±0.11
Heritability estimates, h^2						
Sire	0.02±0.09	0.24±0.07	0.32±0.09	0.38±0.10	0.14±0.05	0.21±0.06
Dam	0.36±0.18	0.36±0.06	0.34±0.06	0.30±0.06	0.21±0.05	0.22±0.05
Sire+Dam	0.31±0.13	0.30±0.05	0.33±0.05	0.34±0.05	0.17±0.05	0.22±0.05

BW0, day old body weight; BW2, body weight at 2 weeks; BW4, body weight at 4 weeks and BW6, body weight at 6 weeks of age; SL4, shank length at 4 weeks; SL6, shank length at 6 weeks of age.

Table 2. Genetic (above diagonal) and phenotypic (below diagonal) correlations of various traits of Gramapriya male line birds

Trait	BW0	BW2	BW4	BW6	SL4	SL6
BW0	--	0.57±0.51** 0.54±0.07* 0.37±0.10**	0.36±0.62** 0.38±0.08** 0.30±0.10**	0.89±0.14** 0.23±0.10** 0.23±0.11**	0.51±0.59** 0.39±0.10** 0.34±0.13**	0.84±0.21** 0.19±0.11** 0.21±0.13**
BW2	0.16	--	0.83±0.07** 0.88±0.03** 0.85±0.03**	0.76±0.08** 0.70±0.07** 0.72±0.05**	0.54±0.17** 0.91±0.02** 0.76±0.06**	0.61±0.13** 0.70±0.07** 0.66±0.07**
BW4	0.14	0.44	--	0.98±0.01** 0.95±0.01** 0.96±0.01**	0.79±0.08** 0.96±0.01** 0.89±0.03**	0.89±0.04** 0.90±0.02** 0.89±0.02**
BW6	0.10	0.40	0.78	--	0.78±0.08** 0.83±0.04** 0.80±0.05**	0.89±0.04** 0.91±0.02** 0.90±0.02**
SL4	0.12	0.35	0.79	0.65	--	0.93±0.02** 0.86±0.04** 0.89±0.03**
SL6	0.09	0.35	0.75	0.81	0.74	--

**Significant ($P \leq 0.01$), genetic correlations given in rows 1, 2 and 3 are based on sire, dam and sire+dam components of variance, respectively. Means with different superscripts in a column differ significantly ($P < 0.05$).

Table 3. Means of immune competence traits of different sexes

Effect	SRBC (titre)	NDV (titre)	PHA-P (mm)
Male	6.7±0.57	4.55±0.29	0.55±0.06a
Female	6.45±0.60	4.4±0.21	0.94±0.11b
Mean	6.57±0.41	4.47±0.17	0.75±0.07

(0.95±0.01 to 0.98±0.01) and positive in direction which indicated that these traits are governed by same set of genes (Rao *et al.* 2004). Results obtained in the present study are consistent with the reports on Vanaraja (Rao *et al.* 2004) an improved variety and gene lines such as Dwarf and Naked neck (Rajkumar *et al.* 2010a, b). Genetic correlations estimated from various components among body weights and shank length at various ages were medium to high in magnitude and positive in direction. This indicates a significant positive relationship between the traits. Dam component of genetic correlation between shank length and body weights at 4 and 6 weeks age was higher as compared to other components indicating the importance of maternal effects. A similar finding was also observed by Padhi *et al.* (2012b) while Mallik *et al.* (2003) Rao *et al.* (2004) reported contrasting findings. Among native breeds, comparable values were reported by Rajkumar *et al.* (2010a) in Naked neck and Haunshi *et al.* (2012) in Aseel and Kadaknath breeds. Phenotypic correlations of similar magnitude were observed by Mallik *et al.* (2003) and Rao *et al.* (2004).

Immune competence: Means of immune competence traits of different sexes are presented in Table 3. The humoral immune response against SRBC and NDV showed no significant difference between the sexes with overall mean titre values of 6.57±0.41 and 4.47±0.17 for SRBC and NDV titres (log₂ values). With respect to humoral immunity, present findings were lower than the reports of Rajkumar *et al.* (2010a) in Naked neck and Reddy *et al.* (2002) in Vanaraja and Gramapriya. A significant (P≤0.01) difference was observed among sexes with respect to cell mediated immunity to PHA-P with overall mean value of 0.75±0.07 mm. The present findings are comparable with the reports of Chatterjee *et al.* (2007) in Aseel and Kadaknath and Rajkumar *et al.* (2012b) in dwarf chicken. However, higher values are reported by Rajkumar *et al.* (2010a).

SUMMARY

High correlation estimates between body weight and shank length revealed strong association among traits. The significant positive association between 4 and 6 weeks shank length and body weight in the Gramapriya male line chicken suggest the breeder to pre-pone the selection to 4 weeks age which economizes the production cost. Besides, the immune competence of the birds was also found to be better, making them suitable male line for production of backyard poultry varieties.

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