Indian Journal of Animal Sciences **85** (9): 991–995, September 2015/Article

Evaluation of male line of Vanaraja (PD1), Vanaraja and control broiler in respect to juvenile traits and genetic analysis of juvenile traits in PD1

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Received: 8 August 2013; Accepted: 19 March 2015

ABSTRACT

Present study was undertaken to compare the male line of Vanaraja, Vanaraja and control broiler in respect to their juvenile traits and to study the genetic parameters in Vanaraja male line (PD1). Body weight, feed conversion, conformation traits and carcass quality were measured. Body weights showed significant difference between different genetic groups and lowest body weight recorded in Vanaraja followed by PD1 and control broiler. The gain in body weights at 2 weeks interval showed significant difference between genetic groups and also differ significantly at different periods within a genetic group. All the conformation traits studied showed significant differences between genetic groups and for increase in shank and keel length during different periods. FCR was significantly better in PD1 and control broiler than Vanaraja. Carcass quality traits measured at 12 weeks of age showed significant difference for abdominal fat% and back+neck% between PD1 and Vanaraja. Vanaraja recorded significantly lower abdominal fat% compared to PD1. Heritability estimates for juvenile body weights in PD1 were moderate in magnitude. All conformation traits showed low to moderate estimates of heritability in magnitude for the traits measured at different ages. Correlations for body weights with different conformation traits were high in magnitude. Correlations between the same traits measured at different weeks showed positive and high correlation. The results revealed that the selection in PD1 may improve the performance of the line and also improve the performance in Vanaraja which is being used as dual purpose backyard poultry through utilization of heterosis for different traits.

Key words: Backyard poultry, Body weight, Conformation traits, Correlations, Heritability, Vanaraja

Backyard poultry farming is very popular in rural and tribal areas where the basic infrastructure for industrial poultry farming is difficult to practice and they mostly rear indigenous/desi fowl for the same where the growth and production potential are low. However, there was always demand for a bird having desirable plumage colour with high performance compared to local indigenous birds with very little change in husbandry practices that is followed for the indigenous fowl. Keeping this in view Vanaraja a commercial dual purpose bird for backyard poultry farming was developed which is a 2-way cross. Evaluations of Vanaraja in respect to different aspects are available in the literature (Haunshi *et al*. 2009, Padhi *et al*. 2012a, Kundu *et al*. 2015). Studies of Vanaraja male line is also available in the literatures (Padhi *et al*. 2012b, Padhi and Chatterjee 2012). However, in the present study an effort was made to compare performance of Vanaraja male line, Vanaraja commercial and control broiler in respect to juvenile traits. In PD1, genetic parameters like heritability and correlation in respect to juvenile traits were estimated. Comparative evaluation of different carcass quality traits in Vanaraja commercial and PD1 was made.

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MATERIALS AND METHODS

Vanaraja male line (PD1) was used for the production of dual purpose backyard poultry. PD1 is being developed from a low performing coloured Cornish population (Ayyagari, 2008). This line is being selected for higher shank length at 6 weeks of age since last five generations. Birds (509) which contributed to the data were produced in a single hatch using 50 sires and 250 dams for the present study. Commercial Vanaraja birds (177) produced through random mating using male and female line and 144 control broiler chicks were used for the study. Chicks were reared up to 8 weeks of age under standard management practices under deep litter system with open side houses under similar management practices throughout the experimental period. At 8 weeks of age 6 male and 6 female each of PD1 and Vanaraja were randomly selected and reared up to 12 weeks of age to study the carcass quality. The chicks were fed *ad lib.* with broiler starter (ME 2900, CP 22) on a maize soybean diet up to 8 weeks of age. The birds kept for carcass quality traits were supplied with broiler finisher diet (ME 3,000 and CP 20) from 8 to 12 weeks of age. Body weight was measured at 0 day, 2, 4, 6 and 8 weeks of age, shank length was measured at 2, 4, 6 and 8 weeks of age, keel length was recorded at 4, 6 and 8 weeks of age. Shank width was measured at 6 weeks of age. Body weight gains from 0–2, 2–4, 4–6 and 6–8 weeks in each bird were calculated. Increase in shank length from 2–4, 4–6 and 6–8 weeks of age in three genetic groups were calculated. Increase in keel length from 4–6 and 6–8 weeks of age were calculated. Feed consumption was recorded up to 6 weeks of age and feed conversion upto 6 weeks of age was calculated. Carcass quality traits were measured at 12 weeks of age in PD1 and Vanaraja commercial by sacrificing 12 birds (6 from each sex) by cervical dislocation. Different carcass quality traits were expressed as % of live weight and cut parts were expressed as percentage of eviscerated carcass weight. Means and standard error of various parameters were calculated using standard statistical methods. Arcsine transformation was carried out for percentage values (<20 and >80) of various parameters prior to analysis. Significant difference between the three genetic groups for various traits was tested by Student's "t" test. Heritability estimates for different parameters in PD1 was made by variance component analysis (King and Henderson 1954). Genetic and phenotypic correlations between different traits were estimated using variance and co variance component analysis (Becker 1975).

RESULTS AND DISCUSSION

Body weights and feed conversion ratio: Table 1 shows means for Vanaraja male line (PD1), Vanaraja and control broiler from day old to 8 weeks of age. Significant difference (P <0.05) between different genetic groups was observed for body weights at different ages of measurements. Control broiler recorded significantly (P <0.05) higher body weight and Vanaraja recorded lowest body weight at all the ages except at 2 weeks. Control broiler being a meat type coloured stock, the body weight was higher than the other two genetic groups. The body weights of PD1 observed in the present study was higher than the reports of Padhi *et al.* (2012a and 2012b) in the same stocks but in earlier generations. The body weight obtained in the control broiler was better than the report of Padhi *et al.* (2012a) in the same line. Body weight obtained in Vanaraja was lowest amongst the three genetic groups and this is desirable as the birds with low body weight can be sustainable in the backyard farming. The body weight observed in Vanaraja was comparable to Haunshi *et al.* (2009) and Padhi *et al.* (2012a). Different variation in body weight may be due to effect of location and other environment factors.

Feed conversion ratio (FCR) from 0–6 weeks of age in different genetic groups are presented in Table 1. FCR differed statistically (P <0.05) between different genetic groups and best FCR was obtained in PD1 followed by control broiler and Vanaraja. Feed conversion ratio from 0–6 weeks showed significant (P <0.05) difference between genetic groups and the Vanaraja showed poor FCR compared to other 2 genetic groups this may be due to poor body weight gain in Vanaraja. Gain in body weights at different period of two week interval are presented in Table 2. Irrespective of genetic groups as the age advances the gain in body weight increases. Significant (P <0.05) difference within genetic group was observed for gain in different period. Between genetic groups for a particular period significant (P <0.05) difference was observed. The gain in body weight from 4–6 weeks of age in PD1 was better than the report of Padhi *et al*. (2012a). The gain in body weight from 2–4 and 4–6 weeks of age was better than the report of Haunshi *et al*. (2009) in Vanaraja. The gain in body weight of control broiler was poor than the report of Padhi *et al*. (2012a). Body weight gains in different genetic groups are mostly influenced by the genetic makeup of the birds.

Conformation traits: Means for different genetic groups for conformation traits at different period are presented in Table 1 and the gain for different period for shank length and keel length are presented in Table 2. Shank length was significantly (P <0.05) higher in control broiler at 2, 4, 6 and 8 weeks of age. Keel length differs significantly (P <0.05) between different breeds at different ages of measurements. Significant (P <0.05) shank length between different genetic groups is in agreement with the reports of Kgwatalala *et al.* (2012), Ajayi *et al.* (2012) and Padhi *et*

Table 1. Juvenile traits in different genetic groups (mean±SE)

Traits	PD1 (509)	Control broiler (144)	Vanaraja (177)
Body weight in g			
BW0	36.30±0.01^{b}	37.66±0.27^{a}	35.24±0.30^{c}
BW2	135.55±0.81^{b}	182.01±2.12^{a}	136.24±1.56^{b}
BW4	322.93±2.37^{b}	426.89±5.24^{a}	290.54±4.62^{c}
BW6	594.62±4.13^{b}	810.47±9.07^{a}	527.75±8.60^{c}
BW8	912.57±6.97^{b}	1248.76±15.06^{a}	757.42±13.94^{c}
Shank length in mm			
SL2	41.10±0.09^{b}	44.49±0.22^{a}	40.60±0.22^{b}
SL4	57.67±0.18^{b}	62.69±0.32^{a}	56.15±0.36^{c}
SL6	74.62±0.20^{b}	80.99±0.41^{a}	72.14±0.46^{c}
SL8	87.37±0.25^{b}	94.56±0.54^{a}	82.30±0.53^{c}
Keel length in mm			
KL4	63.80±0.25^{b}	70.48±0.39^{a}	61.60±0.47^{c}
KL6	82.81±0.28^{b}	97.79±0.64^{a}	77.51±0.48^{c}
KL8	107.31±0.34^{b}	118.02±0.66^{a}	94.88±0.69^{c}
SW6 (mm)	9.46±0.04^{b}	10.66±0.07^{a}	8.91±0.06^{c}
FCR (0–6 week)	3.22±0.22^{a}	3.66±0.38^{ab}	4.49±0.28^{b}

Means having even one common superscript in a row did not differ significantly at (P <0.05). Values in parenthesis in first row indicate number of birds. BW0, BW2, BW4, BW6, BW8 indicates body weight at 0 day, 2,4,6 and 8 weeks of age, respectively. SL2, SL4, SL6 and SL8 indicate shank length at 2, 4, 6 and 8 weeks of age respectively. KL4, KL6 and KL8 indicate keel length at 4, 6 and 8 weeks of age, respectively. SW6= shank width at 6 weeks of age.

al. (2012a). In PD1 the shank length was higher than the reports of Padhi *et al.* (2012a, 2012b) and Padhi and Chatterjee (2012) in the same stock but at early generations. This finding indicates the improvement of shank length over the generations. Shank width recorded at 6 weeks of age also revealed significant difference between the genetic groups and significantly (P <0.05) higher value was obtained in control broiler followed by PD1 and Vanaraja. Increase in shank length between period from 2–4, 4–6 and 6–8 weeks of age in different genetic groups differ significantly (P <0.05) between genetic groups (Table 2). Increase in shank length was significantly (P <0.05) lower in Vanaraja compared to other two genetic groups in all the three periods. The result indicates that as the age advances the increase in shank length decreased in all the three genetic groups. Control broiler being a meat type stock; the increase in shank length during different period was more than the other three genetic groups. It is to be mentioned that during 6–8 weeks of age there was none significant (P <0.05) difference in the increase in shank length between PD1 and control broiler; though the body weight was significantly higher in control broiler indicating the effect of selection in PD1 for higher shank length. The gain in shank length is better in the present study compared to report of Kgwatalala *et al.* (2009). The increase in keel length from 4–6 and 6–8 weeks of age showed significant (P <0.05) difference between different genetic groups. Significant difference (P <0.05) between different genetic groups for keel length was in agreement with the report of Ajayi *et al.* (2012) in indigenous and exotic chicken. The increase in keel length between the genetic groups differ significantly (P <0.05) indicating the effect of genetic groups and the gain from 4–6 weeks of age was highest in control broiler which is expected as it is from a meat type stock.

Carcass quality traits: Table 3 shows carcass quality traits in PD1 and Vanaraja measured at 12 weeks of age. There was no significant (P <0.05) difference between the two genetic groups for different carcass quality traits except for abdominal fat and back+neck cut %. Both the traits showed significantly higher % in PD1 compared to Vanaraja. Pre-slaughter live weight did not differ significantly (P <0.05) between the PD1 and Vanaraja at 12 weeks of age indicating the gain in body weight is better in Vanaraja towards the end of the experiments. Abdominal fat % was significantly lower in PD1 indicating the leanness of Vanaraja carcass, which is an important attributes. Back+ neck cut was only significantly (P <0.05) lower in Vanaraja indicating the better percentage for other prime cuts. Abdominal fat % was lower than the report of Padhi *et al*. (2012a) in same stocks at 8 weeks of age. In both PD1 and Vanaraja leg cut showed higher % followed by breast, back, wing and neck which were in agreement with report of Padhi *et al*. (2012a).

Table 2. Gain in body weight and conformation traits at different period of 2 weeks interval

Traits	PD1 (509)	Control broiler (144)	Vanaraja (177)
Body weight gain (g)			
0–2 week	99.25±0.81^{d}B	144.35±2.04^{d}A	101.00±1.51^{c}B
2–4 week	187.38±2.09^{c}B	244.88±4.71^{c}A	154.30±3.98^{b}C
4–6 week	271.75±3.57^{b}B	383.58±6.88^{b}A	237.21±6.72^{a}C
6–8 week	317.95±5.88^{a}B	438.28±10.58^{a}A	229.69±10.57^{a}C
Shank length gain (mm)			
2–4 week	16.57±0.18^{a}B	17.99±0.29^{a}A	15.55±0.31^{a}C
4–6 week	16.95±0.18^{a}B	18.31±0.32^{a}A	15.99±0.40^{a}C
6–8 week	12.75±0.22^{b}A	13.57±0.35^{b}A	10.16±0.41^{b}B
Keel length gain (mm)			
4–6 week	19.01±0.30^{a}B	27.31±0.55^{a}A	15.91±0.46^{b}C
6–8 week	24.49±0.38^{b}A	20.23±0.72^{b}B	17.37±0.57^{a}C

Values in parenthesis in first row indicate number of birds. Means having different superscript (small letter) in a column for a particular trait and for that genetic group differ significantly P<0.05 for different period. Means having different capital letter in a row differ significantly (P <0.05) between genetic groups.

Table 3. Carcass quality traits in PD1 and Vanaraja commercial at 12 weeks of age

Parameters	PD1 Pooled (12)	Vanaraja Pooled (12)
Live wt (g)	1617±64.88	1540±90.08
	As% of live weight	
Blood %	4.23±0.46	4.30±0.39
Feather %	5.46±0.47	5.75±0.51
Head %	3.39±0.09	3.65±0.09
Shank %	4.42±0.16	4.47±0.15
Eviscerated carcass %	68.09±1.33	68.95±1.24
Giblet %	4.91±0.11	5.08±0.20
Abdominal fat %*	1.16±0.14	0.70±0.14
Ready to cook yield %	74.15±1.35	74.73±1.25
Cut up parts	As% of carcass weight	
Breast %	24.73±0.44	25.79±0.46
Leg %	31.09±0.31	30.55±0.59
Neck +back %*	29.23±0.24	27.93±0.54
Wing %	13.82±0.37	14.50±0.46
Cut loss %	1.14±0.21	1.17±0.26

*Significant at (P <0.05).

Heritability for body weights and conformation traits: Table 4 present the heritabilities for body weights and conformation traits. As the age increases the magnitude of heritability for body weight decreases. Heritability estimates for shank length were low in magnitude at 4 and 8 weeks of age and moderate in magnitude for at 2 and 6 weeks of age. Estimate was low for KL4 and moderate in magnitude for KL6 and KL8. As the age of measurements increases the magnitude of heritability estimates increases for keel length. Estimate of heritability for shank width at 6 weeks of age was moderate in magnitude (0.2910). Heritability for juvenile body weights were moderate to high in magnitude in PD1 and as the age of measurement increase the estimates of heritability decreased similar observation in meat type stocks was reported in PD1 line by Padhi *et al*. (2012b).

The heritability of shank lengths were low to moderate

Table 4. Heritability estimates for different traits in PD1

Traits	h^2_S
BW0	0.6614±0.1763
BW2	0.4298±0.1485
BW4	0.3135±0.1326
BW6	0.3057±0.1314
BW8	0.2710±0.1264
SL2	0.3307±0.1350
SL4	0.1717±0.1114
SL6	0.3161±0.1329
SL8	0.1133±0.1020
KL4	0.1565±0.1090
KL6	0.2190±0.1186
KL8	0.3882±0.1429
SW6	0.2910±0.1293

BW0, BW2, BW4, BW6, BW8 indicates body weight at 0 day, 2, 4, 6 and 8 weeks of age, respectively. SL2, SL4, SL6 and SL8 indicate shank length at 2, 4, 6 and 8 weeks of age respectively. KL4, KL6 and KL8 indicate keel length at 4, 6 and 8 weeks of age, respectively. SW6= shank width at 6 weeks of age.

in magnitude in the present study. As the birds are selected on 6 weeks shank length, the additive genetic effect may be less for the shank length towards higher juvenile ages. Low heritability estimates means that the dominance, epistasis and environment effects are more important than genetic additive effect on the traits in this line. Keel length shows low to moderate heritability and as the age increases the estimates increases. Low to moderate heritability estimates for keel length in different lines are reported (Adeyinka *et al.* 2006, Kumar *et al.* 2010). Shank width shows moderate heritability which indicates this trait can be improved through selection as it has additive genetic effects. It is to be mentioned here that heritability estimates could be affected by methods of estimation, breed, environment effects and sample size. The heritability estimates for different traits in PD1 indicated that these traits can be improved through selection in the lines as per the requirements to develop backyard poultry and to further improve the Vanaraja commercial for which this line is being used as male parent.

Correlation between different traits: Table 5 shows the relationships between different body weights and conformation traits. The correlations between hatch weight and most others traits were generally very low and negative correlation exist between SW6 and KL8. Amongst shank length genetic and phenotypic correlation were positive and moderate to high in magnitude. Similar trends were observed for keel length amongst different ages. Body weights and shank lengths showed strongly and positive genetic correlation when measured at similar age. However, the magnitude of genetic correlation decreased with shank length at early age with body weight at later age. Phenotypic correlation between body weights and shank lengths were positive and moderate to high in magnitude. Genetic correlation between body weights and keel length were positive and moderate to high in magnitude. Genetic correlations between keel lengths at different ages of measurements were high and phenotypic correlations were moderate. Both genetic and phenotypic correlations between body weights and shank width at 6 weeks of age were positive and high in magnitude.

Correlation between different conformation traits revealed that shank length and keel length were highly correlated between similar age of measurement however correlation between late and early age of measurements were low. Correlations between shank lengths with shank width at 6 weeks of age were positive and moderate to high in magnitude. Correlations between BW0 and other traits were low which were in agreement with the reports of Dana *et al.* (2011) and Rajkumar *et al.* (2010). High correlations between body weights obtained in the present study were in accordance with reports of Dana *et al.* (2011), and Padhi *et al.* (2012b). Body weights with shank lengths showed high positive correlations, which is in agreement with the

Table 5. Genetic and phenotypic correlation between different traits

	BW0	BW2	BW4	BW6	BW8	SL2	SL4	SL6	SL8	KL4	KL6	KL8	SW6
BW0		0.18	0.13	0.09	–0.08	0.35	0.37	0.25	0.17	0.31	0.47	–0.07	–0.17
BW2	0.05		0.84	0.55	0.32	0.95	0.89	0.59	0.47	0.77	0.70	0.50	0.66
BW4	0.06	0.50		0.99	0.64	0.58	0.97	0.87	0.75	0.87	0.90	0.61	0.55
BW6	0.12	0.42	0.50		0.90	0.40	0.77	0.92	0.68	0.99	0.68	0.56	0.60
BW8	0.07	0.26	0.36	0.53		0.19	0.36	0.64	0.72	0.32	0.50	0.61	0.46
SL2	0.14	0.67	0.36	0.32	0.21		0.73	0.41	0.49	0.56	0.81	0.30	0.79
SL4	0.08	0.46	0.63	0.40	0.25	0.36		0.88	0.90	0.88	0.76	0.29	0.36
SL6	0.12	0.43	0.53	0.79	0.42	0.35	0.54		0.98	0.92	0.97	0.57	0.68
SL8	0.14	0.30	0.36	0.54	0.78	0.29	0.43	0.55		0.08	0.26	0.42	0.41
KL4	0.11	0.42	0.56	0.42	0.26	0.26	0.63	0.46	0.37		1.00	0.51	0.62
KL6	0.11	0.37	0.43	0.71	0.37	0.30	0.39	0.69	0.42	0.36		0.47	0.58
KL8	0.09	0.21	0.31	0.42	0.71	0.18	0.21	0.35	0.60	0.24	0.38		0.40
SW6	0.12	0.36	0.39	0.70	0.40	0.26	0.40	0.68	0.49	0.37	0.59	0.29	

Above diagonal genetic correlation, below diagonal phenotypic correlation. BW0, BW2, BW4, BW6, BW8 indicates body weight at 0 day, 2, 4, 6 and 8 weeks of age, respectively. SL2, SL4, SL6 and SL8 indicate shank length at 2, 4, 6 and 8 weeks of age respectively. KL4, KL6 and KL8 indicate keel length at 4, 6 and 8 weeks of age, respectively. SW6= shank width at 6 weeks of age.

reports of Padhi *et al.* (2012b) and Ajayi *et al.* (2012). The high correlation estimates indicated that selection of shank length will improve the body weight of the line. Correlations of body weight and keel lengths were high indicating that the improvement in one trait will improve the other. High correlations exist between shank length and keel length measured at different weeks indicating that high shank or keel length birds at lower age will have also high shank or keel length at the age of 8 weeks.

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