Indian Journal of Animal Sciences **78** (3): 289–292, March 2008

Evaluation of immunocompetence, growth and carcass quality traits of different broiler crosses of normal and dwarf dams under intensive system

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Received: 9 March 2007; Accepted: 10 October 2007

ABSTRACT

Broiler crosses, viz. C_1 (PB–1 × PB–2), C_2 (PB–2 × PB–1), C_3 (PB–1 × Dwarf), C_4 (PB–2 × Dwarf) were produced in a single hatch and the immunocompetence and juvenile performance traits up to 8 weeks were studied to evaluate the performance for these traits. Response to Newcastle disease vaccine (ND), sheep red blood cell response (SRBC), cutaneous basophil hypersensitivity (CBH) response, relative spleen and bursa weights, body weight at 2WK, 4WK, 6WK and 8WK, carcass quality traits like eviscerated weight, giblet weight, fat percentage and dressing percentage were measured at 6 weeks of age. The C_4 cross significantly responded to ND vaccine and it was higher than other crosses. The SRBC antibody response in normal dam line crosses (C_1 and C_2) were significantly higher than the dwarf dam line crosses (C_3 and C_4). However CBH response did not differ significantly among the 4 broiler crosses studied. Relative spleen weights in C_1 and C_3 were significantly higher than other 2 crosses. But relative bursa weight in C_3 was significantly higher than other 3 crosses. The body weights at 6 weeks of age and body weight gains between 4 to 6 weeks differed significantly among the 4 crosses. Among the 4 crosses C_1 ranked first, while, the C_4 broiler cross ranked last for 6WK body weight. At 8WK, body weights of normal dam line crosses differed significantly from the dwarf dam line crosses. Carcass quality traits, such as giblet weight, eviscerated weight and dressing percentage were significantly better in normal dam line crosses compared to dwarf dam line crosses. Crosses involving dwarf dam line were not at par with normal dam line crosses for body weight traits. It indicated the incompletely recessive nature of the dwarf gene in heterozygous form (Dw^+/dw). However, for immunocompetence traits no definite trend was observed between normal and dwarf dam line crosses.

Key words: Body weight, Carcass quality traits, CBH response, SRBC response

Lines selected for improved immune responses exhibit a negative association with characteristics such as juvenile growth rate and egg production (Parmentier *et al.* 1996). Yonash *et al.* (1996) also suggested that selection for immune response influences maturation of the immune system. Immunocompetence traits are valuable markers to develop the birds for semi-intensive and rural poultry production systems. The sex-linked dwarf gene introgression in normal broiler parents gave better adaptability under semi-intensive and rural managements. In addition to the body weight other traits like dressing percentage, feed efficiency, and mortality are also important for broiler crosses. In the present study an attempt has been made to evaluate the performance of broiler crosses produced both by normal dam line and dwarf dam line for immunocompetence and growth traits.

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MATERIALS AND METHODS

Genetic stocks and husbandry

Broiler lines PB–1 (sire line) and PB–2 (dam line), and a dwarf broiler gene line, which were under continuous selection for body weight were utilized to generate crosses. Broiler crosses, viz. C_1 (PB–1 × PB–2), C_2 (PB–2 × PB–1), C_3 (PB–1 × Dwarf), C_4 (PB–2 × Dwarf) were produced in a single hatch. Numbers of birds were 163 chicks in C_1 cross, 159 chicks in C_2 cross, 149 chicks in C_3 cross, and 172 chicks in C_4 cross. All the 4 crosses were housed on deep litter pens and brooding was provided up to 4 weeks. Recommended floor, feeder, water spaces were provided. Starter ration containing 22% CP and 2900 Kcal ME was provided up to 3 weeks followed by finisher diet containing 20% CP and 3100 Kcal ME up to 8 weeks of age.

Immune response traits

Response to SRBC: At 6 weeks of age, 32 birds from each cross were intravenously immunized with 0.1 ml of 0.5%

SRBC in normal saline. Blood samples were collected 5 days after immunization and antibody titres against SRBC were determined by haemagglutination method using 0.75% SRBC (Wegmann and Smithies 1966). Antibody titers were expressed in the log2 of the highest serum dilution giving complete agglutination.

Response to ND vaccines: All the birds were immunized with ND (F) at fifth day and ND Lasota at 28th day of age. At 42 days of age blood was drawn from 12 birds of each cross and serum was harvested. Antibody response was determined using ELISA as per the instructions of the manufacture.

CBH response: At 6 weeks of age wattle thickness was measured and 100µg of PHA-P in 0.1 ml was injected into wattle of 6 birds in each cross. The thickness of wattle was measured 24 h after PHA-P inoculation and thickness index was calculated using formula, thickness index = (post injection wattle thickness)/ (pre injection thickness) ×100 (Corrier and Deloach 1990).

Lymphoid organ weights: At 42 days of age 10 birds from each cross were weighed and sacrificed by cervical dislocation. Bursa of Fabricus and spleen were separated from each bird and weighed individually. Organ weights relative to body weight were determined.

Body weights, feed efficiency and carcass quality traits

Birds were individually weighed at 2, 4, 6 and 8 weeks of age. Throughout the experiment feed consumption was recorded on pen basis and feed efficiencies were calculated at 6 weeks of age. Carcass quality traits were recorded after 6 weeks of age. They were giblet weight, eviscerated weight, dressed weight and dressing percentage.

Statistical analysis

Means of all the traits were compared between groups by Duncan's multiple range test (DMRT) to find out the significant difference if any between the genetic groups.

RESULTS AND DISCUSSION

Immunocompetence traits

Response to SRBC, ND vaccine and PHA-P: Humoral response measured as response to SRBC at fifth day post inoculation titres expressed in $\log_2$ are presented Table 1. The average response to SRBC in C_1 and C_2 was significantly (P=0.05) higher than the other 2 crosses in which dwarf was one of the parent. SRBC titre was highest in C_2 cross (4.22). Significant difference in SRBC response was also obtained by others in layers (Reddy *et al.* 2005, Chatterjee *et al.* 2006). Normal dam line crosses were significantly different from dwarf dam line crosses for SRBC response. However, significant difference in humoral immune response to SRBC could not be observed between normal dam line crosses and between dwarf dam line crosses. Present findings of HA titre in broilers are comparable to early workers (Dunning ton *et al.* 1989, Nath 1999, Siva Raman *et al.* 2003). However, Niranjan *et al.* (2006) observed higher titre value in Red Cornish population, which might be due to breed difference.

Response to ND vaccine was highest in C_4 cross followed by C_1 cross, C_3 and C_2 crosses (Table 1). The titre to ND vaccine was significantly (P=0.05) higher in the C_4 cross than C_1cross and C_3 cross. The ND titre of C_1 was significantly higher than C_2 cross. However, this titre of C_3 did not differ significantly than C_2. The ND titre of C_4 cross was lower than earlier report in pure Dahlem Red population (PDP 2003). However, the ND titre in the crosses of Dahlem Red with other population was higher than the present study, which might be due to genetic group difference.

To estimate the T-cell activity of crosses, *in-vivo* T-cell responses to PHA-P were estimated. Cell mediated immune response indicated by wattle thickness among 4 crosses (Table 1) revealed that there was no significant difference between different crosses in the present study. Similar findings were observed between different diallel crosses of White Leghorn pure lines earlier PDP (2005). However, Reddy *et al.* (2005) reported significant difference among 3 feed efficiency groups in White Leghorn population. Cheng and Lamont (1988) also reported significant response in White Leghorn populations.

In the present study ND titers are significantly higher in lower body weight cross C_3 (PB–1× Dwarf), as compared to other 3 crosses having significantly higher body weights. This finding confirms the earlier findings that lines selected for improved immune responses exhibit a negative association with characteristics such as juvenile growth rate and egg production (Parmentier 1996). On the contrary, SRBC titers were significantly higher in higher body weight crosses (C_1 and C_2) as compared to lower body weight crosses (C_3 and C_4).

Table 1. Response to ND vaccine, SRBC response ($\log_2$) and PHA-P response in broiler crosses

Genetic group	ND titre (ELISA)	SRBC titre	PHA-P response	R.spleen weight(g)	R.Bursa weight(g)
C_1(PB–1 × PB–2)	2026.60^{b}	4.0000^{a}	205.57^{a}	2.840^{a}	0.876^{b}
C_2 (PB–2 × PB–1)	1602.80^{c}	4.2188^{a}	209.63^{a}	2.514^{b}	0.734^{b}
C_3 (PB–1 × Dwarf)	1838.50^{bc}	3.1875^{b}	226.71^{a}	3.235^{a}	1.412^{a}
C_4 (PB–2 × Dwarf)	2693.00^{a}	3.1875^{b}	193.83^{a}	2.278^{b}	0.989^{b}

Means in the column with same superscript do not differ significantly (P≤0.05).

Lymphoid organ weights

The relative spleen weights of C_1 cross and C_3 cross were significantly (P=0.05) higher (Table 1) than the other 2 crosses. Relative bursa weight was significantly (P=0.05) higher in C_3 cross than the other crosses. These results indicated that C_3 crosses have higher lymphoid organ weights reflecting higher immune competence.

Juvenile body weights and weight gains

The mean body weights of PB1 and PB2 reciprocal crosses were significantly (P=0.05) higher (Table 2) than dwarf dam line crosses. The mean 2 WK body weight did not differ significantly among 4 broiler crosses except the C_2 cross. Average 4WK body weight of normal dam line crosses were significantly (P=0.05) higher than dwarf dam lines crosses. 2–4 WK body weight gain also observed similar trend. 6WK body weight and 4–6 WK body weight gains differed significantly among the 4 crosses. This body weight was highest in C_1 cross and lowest in C_4 cross; the average 8 WK body weight of normal dam line crosses were significantly (P=0.05) different from dwarf dam line crosses. 6–8 WK body weight gain was significantly different between the 3 crosses, but difference was not significant among dwarf crosses. 8 WK body weight was highest in C_1 cross and it was least in C_4 cross. Feed efficiency did not show significant difference between the 4 broiler crosses. However, C_4 had high feed efficiency (2.45) as compared to other broiler crosses. Body weights at 6 WK and 8 WK in C_1 cross were high as expected. In Dwarf broiler crosses body weights were not at par with the normal broiler crosses. This difference in body weight is attributable to the incompletely recessive nature of the dwarf gene in heterozygous form (Dw+/dw). Our results are in agreement with results obtained by Merat (1984) and Bharadwaj *et al.* (2004).

Carcass quality traits

Means of carcass quality traits are presented in Table 3. Giblet weight (heart, liver, gizzard) in 3 of the crosses were similar except the C_4 cross which was significantly different from the other crosses. But the per cent giblet weight (expressed as per cent weight) was similar in all 4 crosses. The nonsignificant difference of giblet % among different crosses of synthetic broiler was reported by Padhi *et al.* (1987). Dressed weight and dressing percentage of C_4 cross was significantly lower than other 3 crosses which showed no difference. Chatterjee *et al.* (2004) also reported significant difference of eviscerated weight crosses of Nicobari fowl. Merat (1984) found median depression of slaughter weight of crosses produced by dwarfs. The dw allele is incompletely recessive so that slaughter weight of Dw+/dw is not quite equal to that of normal homozygote. In the present study C_4 cross had lowest eviscerated weight, dressed weight and dressing per cent, which may be due to incompletely recessive dwarf gene.

The humoral response to SRBC and relative spleen weight was better in C_1 cross. However, ND titre and relative bursa weight were better where, Dwarf was one of the parents. Our results suggested that C_1 cross was superior to other 3 crosses in respect of juvenile body weights and carcass quality traits. It revealed that PB–1 line will nick well as a sire line and PB–2 as a dam line. Crosses involving dwarf lines are significantly different from the normal broiler dam line crosses for many of the body weight and carcass quality traits. This explains the incompletely recessive nature of dwarf

Table 2. Average juvenile body weights and body weight gains in broiler crosses up to 8 weeks of age

Genetic group	2WK BWT	4WK BWT	6WK BWT	8WK BW	2–4 gain	4–6WK gain	6–8WK gain	F.E* (6WK)
C_1(PB–1×PB–2)	229.86^a	654.00^a	1260.24^a	1465.77^a	424.12^a	600.90^a	205.53^a	2.69
C_2 (PB–2×PB–1)	223.34^b	656.48^a	1208.77^b	1396.27^a	433.70^a	557.19^b	187.50^b	2.48
C_3 (PB–1× Dwarf)	231.60^a	628.16^b	1070.18^c	1309.17^b	396.44^b	439.35^c	238.99^c	2.68
C_4 (PB–2× Dwarf)	229.60^a	598.01^c	999.62^d	1244.47^b	367.67^c	403.23^d	244.85^c	2.45

Means with the same superscript in the column do not differ significantly (P≤0.05); *, Group feed efficiency.

Table 3. Carcass quality traits in broiler crosses at 6 weeks of age

Genetic group	Pre-slaughtered weight (g)	Liver weight (g)	Heart weight (g)	Gizzard weight (g)	Giblet weight (g)	Giblet %	Fat weight (g)	Fat %	Eviscerated weight (g)	Dressed weight (g)	Dressing%
C_1(PB–1 × PB–2)	1248.20^a	42.59^a	6.10^a	29.80^a	78.49^a	6.300^a	14.28^a	11.565^a	790.94^a	888.34^a	71.088^a
C_2(PB–2 × PB–1)	1306.30^a	40.33^a	6.23^a	30.62^a	77.18^a	6.285^a	16.27^a	10.584^a	831.13^a	928.86^a	71.071^a
C_3(PB–1 × Dwarf)	1174.00^a	39.40^a	5.96^a	28.40^a	73.76^a	6.006^a	12.40^a	10.408^a	728.46^a	820.08^a	69.61^a
C_4(PB–2 × Dwarf)	1088.90^b	34.07^b	5.24^b	25.89^a	65.20^b	5.887^a	10.85^a	10.043^a	665.30^b	744.25^b	68.42^b

Means in the column with same superscript do not differ significantly (P=0.05).

gene. It economizes maintenance costs but it is relatively disadvantageous for the broiler production. Further study is needed utilizing the crossbred dwarf dam line instead of pure dwarf dam line to explore the possibility of utilizing dwarf gene line in broiler production.

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