Growth and shank length of autosomal dwarf chicken

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A partial diallel crossing of Rhode Island Red (RIR), White Leghorn (WLH), Fayoumi (FO), Deshi (indigenous) Normal (DN) and Deshi dwarf (DD) chicken was made to produce RIR, WLH, FO, DN, DD, RIR × DD, WLH × DD and FO × DD offspring. A total 709 chicks; 75 RIR, 130 WLH, 100 FO, 70 DN, 66 DD, 80 RIR × DD, 80 WLH × DD and 108 FO × DD were reared according to genotype to study growth performance up to 18 weeks of age. At 19 weeks of age, the crossbreds; RIR × DD, WLH × DD and FO × DD were separated into normal and dwarf genetic groups on the basis of shank length and thus 11 genetic groups; RIR, WLH, FO, DN, DD, RIR × DD normal, RIR × DD dwarf, WLH × DD normal, WLH × DD dwarf, FO × DD normal and FO × DD dwarf were obtained. Day old weight was differed significantly ($p<0.05$) among genotypes. For crossing with *deshi* dwarf, the day old weight of RIR, WLH and FO were decreased by 6.97, 8.71 and 15.32%. Whereas, DD chicks had 9.24% lower day old weight than that of DN. All DD and DD crossbred chicks had lower feed intake ($p<0.01$) at all stages of growth. There were no variations in daily weight gain, feed conversion and mortality among genotypes ($p>0.05$). Apparently, RIR × DD and WLH × DD chicks had lowest mortality. The shank length significantly differed among genotypes at all ages regardless of sex ($p<0.01$) and differences among genotypes increased at older ages. Shank length of pure breeds and normal crossbreds were almost similar and much longer than that of dwarf crossbreds ($p<0.01$).

Keywords: Dwarf gene; growth; shank length

Introduction

The collection, evaluation and conservation of different genotypes is an insurance against future need for breeding (Crawford, 1984). Many poultry scientists are suggested to preserve more genotypes to overcome the vulnerability of monotypic population to meet up the future challenges, likely to occur for the changes in environment, management and food habit. The indigenous stocks in developing countries are disappearing following invasion of improved stocks from developed countries. FAO(1984) therefore, suggested a thorough study of different genotypes among indigenous poultry population and conserve them if found worthy. The use of dwarf gene considered as an important means of reducing adult body size and shank length and maintenance feed requirements of broiler dams (Polkinghorne, 1976, Raut *et al,* 1996). The existence of an autosomal recessive dwarf gene (*adw*) has been identified in *deshi* chicken of Bangladesh (Yeasmin and Howlider, 1998). They reported that deshi dwarf genotype had better egg production and feed conversion than their normal sized counterparts. Therefore, in the present study, a partial diallel crossing was made involving-Rhode Island Red (RIR), White Leghorn (WLH), Fayoumi (FO), Deshi normal (DN) and Deshi dwarf (DD) to produce 8 crossbreds RIR, WLH, FO, DN, DD, RIR x DD, WLH x DD and FO x DD and according to shank length 11 genetic groups: RIR, WLH, FO, DN, DD, RIR x DD normal, RIR x DD dwarf, WLH x DD normal, WLH x DD dwarf, FO x DD normal and FO x DD dwarf progenies to compare the effects of *adw* on growth.

Materials and Methods

A total of 709 chicks obtained from a partial diallel cross involving Rhode Island Red (RIR), White Leghorn (WLH), Fayoumi (FO), Deshi normal (DN) and Deshi dwarf (DD) chicken produced 75 RIR, 130 WLH, 100 FO, 70 DN, 66 DD, 80 RIR x DD, 80 WLH x DD and 108 FO x DD offspring. The growth performances of 8 genotypes in two replications were compared up to 18 weeks of age. At the beginning of 19 weeks, the crossbred; RIR x DD, WLH x DD and FO x DD cockerels and pullets were separated according to shank length (Raut *et al* 1996). Among the crossbreds, both normal and dwarf offspring were found and thus 11 genetic groups; RIR, WLH, FO, DN, DD, RIR x DD normal, RIR x DD dwarf, WLH x DD normal, WLH x DD dwarf, FO x DD normal and FO x DD dwarf were obtained.

At day old, all chicks were individually weighed, wing banded and brooded up to 4 weeks of age. In growing phase, between day old and 126 days of age, a total 709 chicks of 8 different genotypes; RIR, WLH, FO, DN, DD, RIR x DD, WLH x DD and FO x DD housed had 4 replications for comparison among genotypes.

Records were kept on day old and fortnightly on body weight, feed intake, shank length, and mortality according to genotype. Shank length records are presented for day old, 4^{th}, 18^{th} and 46^{th} weeks of age. The shank length was measured as the distance between claw and hock joint. Feed conversion ratio (FCR) was calculated as feed intake per unit live weight gain. Mortality (%) was recorded daily per replication if occurred.

All recorded and calculated data were for a Completely Randomized Design and Analysis of Variance was performed to compare results among crossings of different genotypes.

Results and Discussion

Day old weight was highest in RIR and WLH, intermediate in RIR x DD and lowest in (Table 1) DN, DD, WLH x DD and FO x DD ($p<0.05$). For crossing with *deshi* dwarf, the day old weight of RIR, WLH and FO, were decreased by 6.97, 8.71 and 15.32. Whereas, DD chicks had 9.24% lower day old weight than that of DN. At 4 and 18 weeks of age, there was a little difference in live weight among genotypes. Daily feed intake during 0-4 weeks was highest in RIR, intermediate in WLH and FO and lowest in DN, DD, RIR x DD, WLH x DD and FO x DD. Daily feed intake during 5-18 weeks were highest in RIR, WLH, FO and RIR x DD, intermediate in DN, WLH x DD and lowest in FO x DD and DD ($p<0.05$). At 0-4 weeks, for the effect of dwarf gene, RIR, WLH and FO crossbreds had 29.57, 18.18 and 27.23% lower feed intake than their respective pure breeds RIR, WLH and FO. DD consumed 9.25% less feed than their *deshi* normal counterparts. RIR, WLH and FO dwarf crossbreds ingested 6.63, 9.53 and 16.25% less feed than RIR, WLH and FO pure breeds at 5 to 18 weeks and at 0 to 18 weeks, RIR,WLH and FO dwarf crossbreds ate 8.32, 9.97 and 16.82% less feed than their pure breeds RIR, WLH and FO. Whereas, DD consumed 16.49% and 15.98% less feed than their *deshi* normal counterparts at 5-18 weeks and 0 to 18 weeks of ages. In general, birds having dwarf inheritance had reduced feed intake than those of normal throughout the growing period.

There were no significant variations ($p>0.05$) in daily weight gain, feed conversion and mortality, which could be explained for the variation of genotype. Apparently RIR x DD and WLH x DD chicks had lowest mortality.

The crossing of dwarf *deshi* chicken with different breeds gave both normal and dwarf crossbred progenies in different ratios for different breeds. The shank length (Table 2 and 3) significantly differed among genetic groups at all ages regardless of sex ($p< 0.01$). However, the differences of shank length among genetic groups increased at older ages. There exist less difference between pure breeds and normal crossbreeds, but length in both purebreds and normal crossbreds were much higher than those in dwarf crossbreds in both sexes indicate that DN always had higher shank length than in DD and differences also increased at older ages ($p<0.01$).

Table 1. Performance of Rhode Island Red (RIR), White Leghorn (WLH), Fayoumi (FO), *Deshi* (indigenous) Normal (DN), *Deshi* dwarf (DD), RIR x DD, WLH x DD and FO x DD genotypes during brooding and growing periods.

Parameter	Age (Week)	Genotype								Significance[+]
		RIR	WLH	FO	DN	DD	RIR x DD	WLH x DD	FO x DD	
Day-old weight (g/bird)		36.10[a]	34.45[a]	33.95[a]	30.30[c]	27.50[c]	33.65[b]	31.45[c]	28.75[c]	*
Daily weight gain (g/bird)	0-4	1.85	1.75	1.90	2.45	1.45	2.00	2.30	1.80	NS
	5-18	10.95	9.90	9.70	8.65	6.75	10.70	9.00	7.75	NS
	0-18	8.75	8.10	8.00	7.25	5.55	8.75	7.50	6.45	NS
Dailyfeed intake (g/bird)	0-4	11.50[a]	10.45[b]	10.65[ab]	8.65[c]	7.85[c]	8.10[c]	8.55[c]	7.75[c]	*
	5-18	39.20[a]	30.30[a]	37.85[a]	33.95[b]	28.35[d]	36.60[a]	34.65[b]	31.70[c]	**
	0-18	33.05[a]	32.10[a]	31.80[a]	28.30[c]	23.80[e]	30.30[b]	28.90[c]	26.45[d]	**
Feed conversion	0-4	6.40	6.00	5.70	3.55	5.50	4.05	3.75	4.30	NS
	5-18	3.55	3.90	3.90	3.95	4.20	3.45	3.85	4.05	NS
	0-18	3.75	4.00	4.00	3.90	4.35	3.50	3.85	4.10	NS
Mortality (%)	0-4	0.00	6.45	18.00	5.00	11.65	9.00	14.05	5.00	NS
	5-18	25.00	15.40	7.90	12.15	4.15	4.55	0.00	17.30	NS
	0-18	25.00	20.75	25.90	16.65	15.20	13.55	14.05	21.80	NS

[+] NS, $P>0.05$; *, $P<0.05$; **, $P<0.05$; [abcd], figures with dissimilar superscripts in a row are significantly different.

The differences in day old weight (Table 1) among different genotypes in this study may be mainly attributed to differences in weight of the foundation stocks used to produce crossbreeds. It is evident that when chick weight were expressed as per cent of egg weight, the difference among genotypes almost disappeared indicating chick may be a just function of egg weight. The results coincides the findings of Strong and Japp (1977) and Delpech (1968) who reported the *dw* gene had no detectable effect on the weight of the day old chick. Hutt (1949, 1953 and 1959) concluded the lack of *dw* gene on day old chick size. Arscott and Bernier (1968) reported increased chick weight in *dw* breeds than those in normal.

The data between 4 and 18 weeks of age in Table 1 indicates lack of significant differences among genotypes. But, differences appeared later when the crossbreds were separated into normal and dwarf genetic groups. Such a relatively increased live weight depression at older ages for *adw* gene is supported by Marks (1981). He observed that the relative depressive effect of the *dw* gene on body weight was less at 8 weeks of age than at later ages. The higher growth suppressive effect obtained in this study and observed by Marks (1981) for *dw* gene at older ages is supported by Peterson *et al* (1977). They found growth suppressions of 25.3% and 33.9% respectively at 5 and 20 weeks of age due to incorporation of *dw* gene in WLH chicken. Brody *et al* (1984) showed that the reduction of live weight due to *dw* gene in high and low body weight groups of chicken were 16.83% and 43.73% respectively at 46 days of age indicating higher growth depletion effect of *dw* gene in smaller breeds than that in heavier breeds. Cole (1969) introducing *adw* gene into Cornell line resulted in a 40% reduction in body weight at 18 weeks of age.

Reduce feed intakes (7.75-39.20%) in pure breed × DD crossbreds in comparison with pure breeds observed (Table 1) coincide with Penionzhkevich *et at* (1976). They reported that the dwarf chicken ate 11.2-30.7% less feed than normal Starbro-4 between 9 and 65 weeks of age.

Table 2. Shank length (cm) of male of different normal and dwarf genetic groups at different ages

Genetic group	Age (week)			
	Day old	4	18	46
RIR	2.27^{b}	3.87^{c}	10.00^{d}	10.13^{c}
WLH	2.23^{b}	3.77^{c}	9.20^{c}	9.51^{c}
FO	2.17^{b}	3.40^{c}	9.27^{c}	9.53^{c}
DN	1.73^{a}	3.40^{c}	8.47^{b}	8.63^{b}
DD	1.20^{a}	1.93^{a}	4.17^{a}	4.23^{a}
RIR×DD normal	1.57^{a}	3.03^{b}	9.00^{c}	9.20^{b}
RIR ×DD dwarf	1.23^{a}	2.60^{a}	4.37^{a}	4.73^{a}
WLH×DD normal	1.63^{a}	3.47^{c}	8.80^{b}	8.97^{b}
WLH×DD dwarf	1.67^{a}	2.67^{b}	4.80^{a}	5.03^{a}
FO ×DD normal	2.03^{b}	3.43^{c}	7.97^{b}	8.30^{b}
FO ×DD dwarf	1.53^{a}	2.43^{a}	4.87^{a}	5.00^{a}
Significance^{+}	**	**	**	**

$^{+}$ **, P<0.01; ^{abc}, figures having dissimilar superscripts in a column are significantly different.

Overall feed conversions in dwarf crossbred were higher than in normal crossbreds (Table 1). Marks (1987) noted higher feed utilization in *dw* from 0-8 days in comparison with normal counterparts. Decuypere *et al.* (1991) reported that the feed efficiency of dwarf chicks during the growth period as compared to non-dwarf is generally poor, especially in medium sized or heavy stocks. Guillaume (1973) and Touchburn *et al* (1975) expressed that medium or heavy type chicken's feed to gain ratio was found to be higher in dwarf birds compared to their normal sibilings at all ages. Vlagova and Zlochevskaya (1986) got higher feed conversion efficiency for growth of dwarf than normal broilers.

Table3. Shank length (cm) of female of different normal and dwarf genetic groups at different ages

Genetic group	Age (week)			
	Day old	4	18	46
RIR	2.21^{b}	3.60^{c}	8.16^{b}	8.53^{c}
WLH	2.14^{b}	3.21^{b}	7.99^{b}	8.29^{c}
FO	2.08^{b}	3.33^{b}	8.23^{c}	8.52^{c}
DN	1.96^{b}	2.77^{b}	7.64^{b}	7.89^{c}
DD	1.25^{a}	2.10^{a}	4.47^{a}	4.55^{a}
RIR×DD normal	1.96^{b}	3.43^{bc}	7.62^{b}	7.90^{c}
RIR ×DD dwarf	1.52^{a}	2.40^{a}	5.02^{a}	5.33^{b}
WLH×DD normal	1.84^{b}	3.29^{b}	7.57^{b}	7.80^{c}
WLH×DD dwarf	1.53^{a}	2.28^{a}	5.06^{a}	5.23^{a}
FO ×DD normal	1.89^{b}	2.84^{b}	7.44^{b}	7.78^{c}
FO ×DD dwarf	1.61^{a}	2.59^{a}	4.71^{a}	4.93^{a}
Significance^{+}	**	**	**	**

$^{+}$ **, P<0.01; ^{abc}, figures having dissimilar superscripts in a column are significantly different.

A reduce mortality in RIR x DD and WLH x DD (Table 1) obtained is supported by Leenstra and Pitt (1984). They reported that *adw* dwarfs with lower growth rate had better chance to survive.

Shorter shank lengh of dwarfs in different dwarf genotypes than in normal ones observed was in well agreement with the findings of Willard (1981). In different dwarf crossbred males and females at 18 weeks of age, shank length ranged from 4.37-4.87 and 4.71-5.06 cm respectively. It also almost coincides with the results of Raut *et al*.(1996). They observed that shank length in males and females dwarfs at 20 weeks of age were 6.00±0.03 and 5.10±0.02cm. Increased differences in shank length between dwarfs and normal with increasing age noted in the present study are supported by Petersen *et al.* (1977). They found that difference in shank length in dwarfs were shorter by 9.6 and 20.9% respectively than that of normal at 5 and 20 weeks of age. For both genotypes, shank length increased almost linearly up to 18 weeks of age and remained similar up to 46 weeks of age. Rashid (2000) has reported similar trend of shank length in normal and dwarf crossbreds of RIR, WLH and FO as found in this study. The result of this study reveals that incorporation of *adw* gene to exotic chicken could reduce shank length, adult body size and maintenance feed requirement and therefore, may perform better.

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