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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Effect of Dwarfism on Reproductive and Meat Yield Parameters of Crossbred Chicken

M.A. Rashid[1], M.A.R. Howlider[2], J. Alam[3], Md. Abdur Rashid[4] M.H. Kawsar[5] and S.A. Azmal[1]
[1,3]Bangladesh Livestock Research Institute, Savar, Dhaka, Bangladesh
[2]Department of Poultry Science, Bangladesh Agricultural University, Mymensingh, Bangladesh
[4]Barisal Government Veterinary College, Bangladesh
[5]Rural Poverty Elevation Foundation, Bangladesh
E-mail: marashid31@yahoo.com

Abstract: Twenty four indigenous autosomal dwarf hens were selected and divided equally into 3 groups. Rhode Island Red, White Leghorn and Fayoumi Cocks, 2 for each were placed to each group respectively for breeding. Sixty eggs were selected from each group and hatched in a forced draft incubator. Among those, 36 healthy day-old chicks from each group were selected and reared up to 20 weeks of age. The chicks were identified as normal and dwarf genetic groups at 8 weeks of age. The aim of this study was to observe the reproductive parameters of crosses and parameters related to the meat yield of normal and dwarf genetic group of crossbred chicken under farm condition. Fertility, hatchability on total eggs and hatchability on fertile eggs of cross B (95.57; 68.71; 72.41) were higher ($p<0.01$) than cross A (93.44;63.44;67.62) and cross C (90.92;60.89;67.19). Dead-in-germ and dead-in-shell were statistically higher ($p<0.01$) in cross C than cross A&B. Reduced adult body size, improved feed conversion and higher livability were found in all genetic groups of dwarf crossbred. Among those, White Leghorn was found as the best one also considering its different dressing yields. Advantages of adw gene in terms of a good scavenger could better be exploited by introgressing in exotic smaller breeds like White Leghorn from indigenous dwarf chicken.

Key words: Dwarfism, reproductive, meat yield, crossbred chicken

Introduction

In Bangladesh, it was found that about 86% of poultry meat and 75% of egg are produced by the village level farmers under scavenging system (Alam, 1995). Rearing of indigenous chicken reveals the fact of maximum return with minimum cost by efficient conversion of agricultural by-products and all other human refusal that would other wise go to waste (micro-livestock, 1991). Scavenging chicken are therefore important components in integrated farming system (Barua and Yoshimura, 1997).Although the scavenging chicken are playing a vital role both to the national economy and nutrition, but they are poor meat and egg producers (Ahmed and Huque, 1994 and Huque *et al.*, 1990). Feed efficiency of indigenous chicken is also poor. Sazzad *et al.* (1990) recorded 4.5 kg and 8.8 kg of feed required to produce 1 kg of body weight and 1kg of egg mass respectively for indigenous chicken. On the other hand, exotic breeds are very much sensitive to substandard management and to changes in the quality and quantity of nutrients (Barua and Yoshimura, 1997). Azizul and Reza (1980) got higher mortality in exotic breeds (45.4%) than indigenous chicken (9%). From the study of Huque *et al*. (1992), it is also found that scavenging chicken suffer from severe deficiency of nutrients. As a result, rearing of exotic chicken in scavenging condition is almost impossible. The indigenous genotypes, despite of poor production are well resistant to most of the diseases and are highly adapted to scavenging system, where sub-standard management, poor housing facilities and diseased environment at variable temperature and humidity as prevailed in tropical harsh condition of Bangladesh (Hossain *et al.*, 1991). It is assumed that for successful scavenging rearing in Bangladesh may need a type of chicken having a realistic intermediate meat and egg production between poor producer indigenous and high producing exotic strain with a lower maintenance feed requirement, so that the increased production of the said type above indigenous chicken might be supported by the existing level of feed intake in the backyard system. They should also be more resistant to elevate temperature and humidity.

The indigenous stocks of the country disappearing following invasion of non-adaptive stocks from developed countries, FAO (1984), therefore, suggested a thorough study of the different indigenous population and conserving them, if found worthy. In Bangladesh, recently, the existence of dwarf genotype autosomal recessive (*adw*) in nature has been identified (Yeasmin and Howlider, 1998). They got better feed utilization and higher hen day egg production. Moreover, from the nutrition /economic point of view use of dwarf genotypes already revolutionize broiler industry by decreasing the maintenance feed requirement of the dam lines (Willard, 1981). The dwarf gene is of interest among scientists. Because of, its numerous pleiotropic effects in physiology, nutrition, behavior, pathology etc. (Guillaume, 1976).

In this regard, decreasing adult body size is the important means of reducing maintenance feed requirement, increasing feed efficiency as well as adaptability in a hot-humid tropical environment through the introduction of dwarf types, synthesized by using local autosomal dwarf chicken and exotic breeds might fulfil the demand and increase village level meat and egg production of chicken where there are quantitative and qualitative deficiency of feed. But, before introducing such types of indigenous genotype to scavenging condition, their reproductive efficiency, actual production potentials and requirements are needed to assess under controlled farm condition. Information in relation to this type of local genotype is not available or very scanty. With those ideas in mind, the present work was under taken to study the reproductive performance, reduction in body size, feed conversion efficiency and different dressing parameters of normal and dwarf genetic groups of crossbred chicken.

Materials and Methods

Collection of parent generation and their management: The Research was conducted for a period of 20 weeks from March to July. A total of 24 indigenous dwarf hens almost uniform in body size and age were collected from different district of Bangladesh according to the description of Pandey (1996). The experimental rooms for parent birds were properly cleaned and divided into 3 separated equal sized pens. Fresh rice husk at a depth of 5cm on floor was used as litter. The indigenous dwarf hens were randomly distributed into 3 treatment groups having 8 birds in each. The selected Rhode Island Red (RIR), White Leghorn (WLH) and Fayoumi (FO) cocks, 2 for each were placed into 3 pens respectively. A total of 180 eggs; 60 from each treatment group were collected and hatched in a forced draft incubator. The eggs were candled at 7^{th} and 14^{th} day of incubation and finally fertility, hatchability, dead-in-germ and dead-in-shell were recorded.

Preparation of brooding-cum-growing house and management of chicks: Three selected pens were well prepared for brooding of chicks using electric brooder. Fresh rice husk at a depth of 7.5 cm was used as litter. Randomly selected 36 wing banded day-old chicks from each crossing were distributed in 3 treatment groups equally on the basis of genotypes (RIR LO *adw*; WLH × LO *adw* and FO x LO *adw*) replicating those 3 times in each group and were brooded in separate pens up to 8 weeks. During 6-8 weeks of age the dwarf type was distinguishable. After identifying the dwarf and normal type each wing banded bird was transferred into the individual cage to observe their individual growth performance up to 20 weeks of age. After separating of normal and dwarf among 3 crossbreds the total genetic groups became 6 (i.e. RIR LO*adw* normal and dwarf; WLH LO*adw* normal and dwarf; FO LO*adw* normal and dwarf). Body weight and feed conversion were recorded fort-nightly from 8-20 weeks of age. At 20 weeks of age male and female of normal and dwarf genetic group each of 3 birds, belonging the genotype WLH X LO*adw* were slaughtered and different parameters recorded to observe their muscular and skeletal differences. Identical as well as appropriate care and management were under taken to all the birds during crossing of parents, brooding and growing period of the chicks in regarding to the floor space, feeding, watering, lighting as well as sanitation and vaccination. Parent ration (crossing of cocks and hens), chick starter (0-6 weeks) and grower mash ration (7-20 weeks) formulated as per the BDS (1988) standard with locally available feed ingredients were supplied to the birds on *adlibitum* basis. Fresh clean water was supplied all the time. The birds were exposed to a lighting system, started with 24h/day and was decreased @ 1 hour per week until the night lighting is over, there after the birds were exposed only to natural day light up to 20 weeks of age. Strict hygienic and sanitation were maintained and the birds were vaccinated against Baby Chick Ranikhet , Ranikhet, Fowl Pox and Fowl Cholera diseases.

Calculation of different parameters: Fertility was calculated by total number of fertile eggs divided by total number of egg set, whole multiplied by 100. Hatchability on total eggs and hatchability on fertile eggs were obtained through the number of chicks hatched divided by total number of eggs set and total number of fertile eggs respectively, whole multiplied by 100. Dead-in-germ and dead-in-shell were determined by total number of dead-germs in-shell and total number of dead-chicks in-shell respectively, divided by total number of fertile eggs, whole multiplied by 100. Feed conversion efficiency was calculated through the ratio of feed consumption (g) and weight gain (g). Dressing percentage obtained from the total dressed meat divided by the live weight, whole multiplied by 100.

Statistical analysis: All the recorded data were subjected to fit Completely Randomized Design (CRD) and analysis of variance was performed to compare among the different crossings and genetic groups.

Results and Discussion

Reproductive parameters: The hatching results from Table 1 evident that, fertility of cross B (95.57) was significantly (P<0.01) higher than cross A (93.44) and C (90.92). Hatchability on total eggs and on fertile eggs

Table 1: Hatching results of different crossings.

Parameters	Crossing			LSD (SED) and level of significance
	A(RIR×LO*adw)*	B(WLH×LO*adw)*	C(FO×LO*adw)*	
Fertility	93.44[b]	95.57[a]	90.92[c]	**
Dead-in-germ	17.62[a]	15.00[b]	18.43[a]	**
Dead-in-shell	14.43[a]	12.13[b]	14.68[a]	**
Hatchability on total egg	63.44[b]	68.71[a]	60.89[c]	**
Hatchability on fertile egg	67.62[b]	72.14[a]	67.19[b]	**

RIR = Rhode Island Red; WLH = White Leghorn; Fo = Fayoumi; Lo*adw* = Local (indigenous) dwarf.
** Significant (P<0.01). Different superscripts in the same row differ significantly.

Table 2: Different growth parameters of 6 genetic groups of chicken between 9-20 weeks of age

	Parameters							
	Live weight (g/bird)				Feed intake (g/bird/day)			
	10 weeks		20 weeks		10 weeks		20 weeks	
	Male	Female	Male	Female	Male	Female	Male	Female
Genetic group (G)								
RIRN	455	310	1435.0[abc]	1345.00[a]	53.00	44.00	103.50	112.35
RIR*adw*	395	285	1250.00[bc]	1335.00[ab]	45.17	41.00	89.67	100.00
WLHN	425	285	1340.0[abc]	1250.00[a]	49.00	40.00	98.17	95.00
WLH*adw*	325	275	1125.00[a]	1090.00[c]	42.84	35.00	88.50	86.00
FoN	370	295	1270.0[abc]	1240.0[abc]	52.34	42.27	95.00	89.00
Fo*adw*	310	255	1125.0[abc]	1180.00[bc]	49.50	39.17	93.50	86.84
Mean	380	283.33	1257.50	1240.00	48.64	40.29	94.72	94.86
level of significance								
G	**		NS		**		**	
S	**		NS		**		NS	
G×S	(25.82)[NS]		214.395 **		3.015**		7.023**	

	Feed conversion ratio				Survivability % (up to 20 weeks)
	10 weeks		20 weeks		
	Male	Female	Male	Female	
RIRN	7.59	8.55	5.96	7.88	94.44
RIR*adw*	8.75	8.56	5.62	4.04	97.22
WLHN	4.61	6.67	5.40	6.06	97.22
WLH*adw*	4.29	5.69	4.65	4.43	100
FoN	5.82	9.06	5.80	8.25	91.67
Fo*adw*	5.74	6.91	5.70	5.59	94.44
Mean	6.13	7.57	5.52	6.04	-
level of significance					
G	**		**		**
S	**		NS		
GxS	(0.694)[NS]		2.19**		

RIRN = Rhode Island Red Normal crossbred; RIR*adw* = Rhode Island Red dwarf crossbred; WLHN = White Leghorn Normal crossbred; WLH*adw* = White Leghorn dwarf crossbred; FON = Fayoaumi Normal crossbred; FO*adw* = Fayoumi dwarf crossbred. NS = Non significant (P>0.05); ** Significant (P<0.01)

were also higher (P<0.01) in cross B (68.71 and 72.14) than that of cross A (63.44 and 67.62) and cross C (60.89 and 67.19). Though, hatchability on total eggs in cross A showed higher than cross C but there is no statistical difference between them. The differences among the crosses might be due to breed characteristics of male and/or due to preferential mating. Uddin (1989) also got the similar hatchability results.

Table 3: Muscular and skeletal differences in two genetic groups of White Leghorn crossbred chicken

Parameters		Genetic group (G)			Level of significance	
	Sex (S)	WLHN	WLH*dw*	Mean	G	S
Live weight (g/bird)	Male	1360.00	1287.50	1323.75	NS	**
	Female	1060.00	980.00	1020.00		
	Mean	1210.00	1133.75	1171.88		
Blood weight (%)	Male	5.70	5.75	5.73	NS	*
	Female	5.30	4.20	9.75		
	Mean	5.50	4.98	5.24		
Feather weight (%)	Male	7.20	5.75	6.48	**	**
	Female	6.85	5.10	5.98		
	Mean	7.03	5.43	6.23		
Skin weight (%)	Male	5.55	3.85	4.70	**	**
	Female	6.35	6.25	6.30		
	Mean	5.95	5.05	5.50		
Shank length (cm)	Male	8.25	6.90	7.58	**	**
	Female	6.90	5.55	6.23		
	Mean	7.58	6.23	6.90		
Thigh bone length (cm)	Male	8.25	6.90	7.58	**	**
	Female	6.90	5.55	6.23		
	Mean	7.58	6.23	6.90		
Thigh meat weight (%)	Male	11.45	12.20	11.83	NS	**
	Female	7.55	7.30	7.43		
	Mean	9.50	9.75	9.63		
Drumstick meat weight (%)	Male	7.00	9.30	8.15	**	**
	Female	5.15	9.20	4.68		
	Mean	6.08	6.75	6.41		
Drumstick bone length (cm)	Male	10.50	9.75	10.13	**	*
	Female	10.10	8.55	9.33		
	Mean	10.30	9.15	9.73		
Heart weight (%)	Male	0.55	0.60	0.58	*	**
	Female	0.30	0.45	0.38		
	Mean	0.43	0.53	0.48		
Liver weight (%)	Male	1.45	1.90	1.68	NS	**
	Female	2.90	2.70	2.80		
	Mean	2.18	2.30	2.24		
Gizzard weight (%)	Male	1.55	1.05	1.30	**	**
	Female	2.50	1.55	2.03		
	Mean	2.03	1.30	1.66		
Breast meat weight (%)	Male	8.35	9.10	8.73	NS	**
	Female	12.40	12.30	12.35		
	Mean	10.38	10.70	10.54		
Intestine length (cm)	Male	125.00	122.00	123.50	NS	NS
	Female	107.50	40.50	74.00		
	Mean	116.25	81.25	112.86		
Dressed weight (%)	Male	60.10	71.85	65.98	NS	*
	Female	60.94	58.95	59.94		
	Mean	60.25	65.40	62.96		

WLHN = White Leghorn Normal crossbred; WLH*adw* = White Leghorn dwarf crossbred;
NS = Non significant (P>0.05); * Significant (P<0.05); ** Significant (P<0.01)

However, Cross C showed statistically higher (P<0.01) in both dead-in-germ (18.43) and dead-in-shell (14.68) than cross B (15.00 and 12.13) and then cross A (17.62 and (14.43).

Growth parameters: Live weight: At 10 weeks of age RIR, WLH and FO dwarf crossbreds had 11.11, 15.9 and 15.03% depressed live weight respectively in comparison with their normal counterparts (P<0.01). The respective weight reduction at 20 weeks was 7.01, 14.48 and 8.17%.

However, at 20 weeks of age live weight reduction for dwarfism was more in males than in females (P<0.01). At all stages a remarkable live weight depression for dwarfism is supported by Yeasmin & Howlider (1998). Moreover, under the present study, more weight reduction at all ages in WLH*adw* genetic group than in RIR*adw* and FO*adw* indicate the more proportionate weight reduction for dwarfism occurred in smaller breeds than that in heavier breeds. This finding is agreed with the Broady *et al.* (1984), who got 16.83 and 43.73% live weight depression in high and low body weight groups of chicken respectively. Even then, more live weight reduction at 20 weeks as found in males than the females got support from Petersen *et al*.(1977).

Feed intake: At all stages higher feed intake recorded in normal genetic group than their dwarf counterparts and it was highest for RIR followed by FO and WLH crossbreds, reduction in feed

Intake for dwarfism at 10 weeks in RIR, WLH and FO was 12.58, 14.34 and 6.70% and at 20 weeks it was 13.80, 10.69 and 2.03% respectively. However, in the current study, reduction in feed intake ranged from 2.03 to 15.34 percent which is almost similar to the findings of Penionzhkevich *et al.* (1976), Coquerelle and Merat (1997).

Feed conversion: Better feed conversion in dwarfs than their normal counterparts obtained at different ages is in agreement with khan (1981), Merat (1990) and Yeasmin and Howlider (1998).

Survivability: Higher survivability for dwarfs than their normal ones is supported by khan *et al.* (1987), who observed lower mortality in dwarf layers than in normal bodied broilers. This finding also agreed with Decuypere *et al.* (1991).

Muscular and skeletal parameters: From the results of different dressing parameters (Table 3) dwarf birds showed higher for drumstick meat weight (p<0.01) and heart weight (p<0.01) than their normal counterparts. However, breast and thigh meat weight, liver weight as well as dressed weight also found higher but statistically non significant. On the other hand, normal crossbred found highly significant (p<0.01) than dwarf counterparts for feather, skin and gizzard weight, shank length as well as thigh and drumstick bone length. However, normal birds showed higher but non significant for liver and blood weight and also for intestine length.

However, males found superior to females for liver weight, drumstick and thigh meat weight, heart and feather weight as well as shank and thigh bone length (p<0.01). Where as blood weight and drumstick bone weight was (p<0.05) but, intestine length found statistically non-significant in both the genetic group. On the other hand, breast meat weight, liver weight gizzard and skin weight were higher (p<0.01) for females than males in both the genetic group.

In the current study, the dressing parameters discriminated that different bone length Was higher in normal that in dwarf birds. Obviously, larger the bones, larger the skeleton, which proves the larger body size of the normal sized birds. Consequently, larger body size required more feed. Simultaneously, the higher gizzard weight and intestinal length in normal birds certainly indicates its higher feed consumability than that of dwarf counterparts. Feather and skin weight highly correlated with the surface area. In this study, the heavier skin weight in normal than in dwarfs also justifies the more surface area in normals than their dwarf counterparts.

Although, there are very scanty information regarding this type of crossbred chicken to compare the results. But, in the present study, higher thigh meat, breast meat yield as well as the dressing percent in dwarfs than in normals may be due to the compactness of body stature. However, higher heart weight and similar blood weight (statistically) perhaps indicates more blood circulating capacity of dwarfs leading to accelerated physiological function needed for efficient nutrient utilization. This result is in confirmatory with khan *et al*. (1987). He found highest dressing percentage and the lowest cost of producing 1 kg meat in a progeny of dwarf birds. However, higher breast meat percent in the females found in the current study is supported by Grey and Richardson (1988) and Howlider (1988) who got 3.5% higher breast meat in females than in males.

Considering the results of the current study, it was concluded that introgression of *adw* gene from indigenous to exotic breed should decrease the adult body size as well as feed intake of crossbred dwarfs in comparison with their normal sized counterparts, which is the prerequisite for the scavenging chicken. Although, further mass trial is needed before introducing this type of chicken as scavenger but the advantage of *adw* gene in terms of satisfactory fertility and hatchability, reduced adult body size, reduced feed intake, improved feed conversion and higher meat yield as well as livability could better be exploited by introgressing *adw* gene in smaller breeds like White Leghorn.

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