Bangladesh Journal of Animal Science
Journal homepage: http://www.banglajol.info/index.php/BJAS

Phenotypic characterization and productive potentialities of indigenous dwarf chicken of Bangladesh

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Abstract

The study was conducted to investigate the phenotypic features, morphometry and production potentialities of indigenous dwarf chicken (IDC) of Bangladesh under intensive management condition. A total of 48 females and 12 males were collected from different districts and the experiment was performed at BAU Poultry farm for a period of 75 weeks. The predominant plumage and skin color were black and white, respectively. The average shank length, shank circumference and live weight (28 weeks) in adult males and females were 7.5 and 4.69 cm, 6.28 and 3.69 cm, and 1.77±0.38 and 1.10±0.077 kg, respectively. The reduction of live weight for dwarf male and female chickens relative to their normal shanked counterparts (NSC) at same age was 12.91 and 16.91%, respectively. Hen day egg production, average egg weight, average feed intake and FCR (feed conversion ratio) of IDC were recorded 37.43%, 38.25 g, 69.57g and 4.58, respectively. The average age and weight at sexual maturity were recorded as 166.53 days and 1093 g, respectively. IDC consumed 11.13% less feed than NSC during 1-20 weeks. Survivability of IDC up to 0-8, 1-23 and 24-75 weeks of age were found 97.25, 94.90 and 95.24%, respectively. The study reveal that IDC had relatively lower adult weight and consumed less feed without affecting egg production compared to NSC under intensive management condition and could be exploited its potentiality for development of mini layer under semi-scavenging system of Bangladesh.

Key words: Dwarf chicken, Morphology, Morphometry, Production potential, Bangladesh

 Bang. J. Anim. Sci. 2016. 45 (1): 52-61

Introduction

Indigenous chickens reared in the villages still remains the main genetic resource and plays an important role in rural livelihood, income generation for females and provides important animal protein for large human population in Bangladesh. The national share of commercial strain of chickens and indigenous family poultry in terms of egg production is almost equal (50:50) and that of meat production is 60:40 (Bhuiyan, 2011). About 89 % of rural households keep chicken with an average flock size of 5.33 per holding under backyard scavenging system (Bhuiyan *et al.,* 2013). The preferences of indigenous chicken are for pigmentation, taste, leanness, firmness, flavor and suitability for special dishes (Islam *et al.,* 2002). Although indigenous chickens have lower in productivity but they are adapted to tropical climatic condition (Islam *et al.,* 1981). There are 255.31 million chickens in commercial and subsistence production systems (DLS, 2014). Bangladesh possesses a wide variety of chicken mostly of non-descript in nature. The available indigenous chicken genetic resources of the country may be classified as non-descript Deshi which includes Deshi Full Feathered, Deshi Cap Headed and Deshi Dwarf; Naked Neck, Hilly, Aseel, Red Jungle Fowl, Frizzle Feathered, Yasine and Tiger chicken. IDC is found very few in number across the country. However, they are relatively more concentrated in some selected areas of Mymensingh, Tangail, and Rangpur district of Bangladesh (Personal communication). Cole (1969) first described autosomal dwarf (*adw*) chicken and its inheritance. Dwarfing suppress adult weight and feed intake without affecting egg production and egg quality (Barot *et al.,* 1996), and reduce maintenance feed

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(Polkinghorne, 1976) and increase heat tolerance (Nichelmann *et al.,* 1989). Pandey (1996) speculated the potentialities of dwarf as a future commercial hen which could be a future vista for poultry breeding. Yeasmin and Howlider (1998) reported dwarf gene in Bangladeshi indigenous chickens were partially recessive autosomal in nature. However, their objective based morphological study has not yet been conducted. In addition, the potentiality of *adw* gene was not sufficiently explored and exploited in improving economic traits of indigenous chicken of Bangladesh. Therefore, the present study was aimed for phenotypic, morphometric and production potentialities of Bangladeshi IDC under intensive management condition.

Materials and Methods

The experiment was carried out at Bangladesh Agricultural University (BAU) Poultry Farm, Mymensingh to study the phenotypic characteristics of IDC of Bangladesh. Accordingly, (48 females and 12 males) dwarf chickens were collected from different districts namely Rangamati, Mymensingh, Tangail, Rangpur and Barisal based on their phenotypic features to develop a foundation stock. After collection, they were quarantined and maintained at BAU poultry farm during the experimental period from April 2013 to September 2014. The hatching eggs were collected from the foundation stock and incubated at BAU poultry farm. Day old chicks were collected from the hatchery, wing banded, and brooded separately with a stocking density of 100 cm^2/ chick. All birds were fed *ad libitum* on pre-starter (0-5 weeks), starter (6-10 weeks), grower (11-18 weeks) and breeder diet containing 2900, 2850, 2900 and 2900 kcal/kg energy and 22.8, 22, 20.8 and 20.5% CP, respectively. Artificial insemination was practiced for all experimental birds. Birds have been reared about 75 weeks of age and recorded various qualitative and quantitative data. During rearing period, live weight at different stages, feed intake, feed conversion, growth rate, survivability, egg weight, hen day egg production, age and weight at sexual maturity of birds were recorded. Different morphological variants such as color of shank, skin, eye, beak and ear lobes, comb type, plumage colors and patterns were observed only from adult chicken and recorded accordingly. Morphometric measurements like live weight and shank length at different ages, body length, comb length, shank circumference, keel length, were taken by electric weighing balance, measuring tape and scale. Descriptive statistics such as mean, standard error, frequency and percentage were used to analyze the data using Statistical Package for Social Sciences (SPSS, version 16.0).

Results and Discussion

Morphological features

The morphological features including plumage, comb, shank, earlobe and egg color were observed in IDC (Table 1). Plumage color of the dwarf chickens were found black, blackish red, reddish black, golden and blackish golden, black with white spot while black color (41.11%) was most predominant. Bhuiyan *et al.* (2005) also found maximum proportion of plumage color of native chicken was black (75%) and Sarker *et al.* (2014) reported that the most predominant plumage color of the local chicken population was reddish black (33.13%) then blackish red (13.5%). These two findings support the present study. Faruque *et al.* (2010) found that Black brownish constituted the maximum proportion (40%) of plumage color followed by red brownish (35%) which disagree with the present findings. Genotypic difference is the major contributory factor for this variation. The proportion of shank color was found 27.78, 23.33, 22.22, 16.67 and 10.0%, respectively for black, slate, yellow, yellowish and white color. These results partially agree with the findings of Faruque *et al.* (2010) and Khan *et al.* (2004) where they found 40% white shanked indigenous chicken and almost 100% yellow shank in Hilly chicken, respectively. The most frequent beak color was yellow (44.44%), followed by black (33.33%) and white (22.22%). The highest proportion of earlobe color was reddish white (44.44%) followed by red (40%) and white (15.56%). Sarker *et al.* (2014) found that the earlobes were mainly reddish white (44.79%) while Bhuiyan *et al.* (2005), Khan *et al.* (2004) and Faruque *et al.* (2010) were reported 80% red in native, 100% red in Hilly and 80% white in indigenous chicken, respectively which is not consistent with the present finding.

Table 1. Morphological characteristics of indigenous dwarf chicken of Bangladesh

Trait	Characteristic features	No. of observation	Frequency (%)
Plumage color	Black	37	41.11
	Blackish red	11	12.22
	Reddish black	11	12.22
	Golden	10	11.11
	Blackish golden	16	17.78
	Black with white spot	5	5.56
Shank color	Black	25	27.78
	Slate	21	23.33
	Yellow	20	22.22
	Yellowish	15	16.67
	White	9	10.00
Eye color	Black	90	100.00
Ear lobe color	Red	36	40.00
	White	14	15.56
	Reddish white	40	44.44
Beak color	Black	30	33.33
	White	20	22.22
	Yellow	40	44.44
Comb color	Bright red	60	66.67
	Reddish	30	33.33
Skin color	White	81	90.00
	Yellow	9	10.00
Egg shell color	Light brown	49	76.56
	White	15	23.44
Comb type	Single	90	100.00

This variation might be due to differences of genotype. Both male and female possessed single comb with bright red (66.67%) and reddish (33.33%) in color. Similar findings was reported by Faruque *et al.* (2010) and Bhuiyan *et al.* (2005) where they observed 100% single comb having 70% red color and 97% single comb with 59% bright red color, respectively in indigenous chicken. The most frequent color of skin in IDC was found white (90%) which is similar to the result (92.22%) of Sarker *et al.* (2014). IDC of this study was found to lay both light brown (76%) and white (24%) eggs which agree with the findings of Bhuiyan et al. (2005). where they reported the indigenous chickens in Bangladesh laid light brown (67%) and white (27%) eggs.

Morphometric measurements

Average measurements of comb, neck, body, wings and keel length are shown in Table 2. Comb length of adult dwarf male and female chickens were 12.61 and 5.13 cm, respectively which is similar to the result of Faruque *et al.* (2010) where they reported comb length of native hen was 5.21 cm. Body and wing length of adult dwarf male and female were 46.23 and 39.46 cm, and 18.25 and 14.88 cm respectively which agree with the findings of Faruque *et al.* (2010) They found body length of male and female were 43.64 and 37.03 cm. Sarker *et al.* (2014) and Uddin *et al.* (2011) observed that average wing length of indigenous chickens were 12.60± 0.07 and 17.70 ± 2.13 cm, respectively.

Table 2. Morphomatric characteristics of indigenous dwarf chicken of Bangladesh

Trait	Mean ± SE	
	Male (n=15)	Female (n=60)
Comb length (cm)	12.61±0.31	5.125± 0.09
Neck length (cm)	24.78±0.48	21.98 ± 0.13
Body length (cm)	46.23± 0.64	39.46 ± 0.18
Wing length (cm)	18.25± 0.29	14.88 ± 0.11
Keel length (cm)	18.77± 0.19	15.46 ± 0.11

Keel length of adult dwarf chickens were 18.77 and 15.46 cm which is partially agree with the findings of Khan *et al.* (2004) where they found keel length of male and female hilly chicken was 12.56 and 10.35 cm, respectively. Sarker *et al.* (2014) also reported that keel length of indigenous chicken was 9.10 cm which is lower than the present study.

Live weight and Growth rate

The live weight and growth rate of male and female IDC and NSC at four weeks interval up to 28 weeks of age are given in Table 3. The live weight of male and female IDC was 1.77±0.38 and 1.10±0.077 kg, respectively at 28 weeks of age while NSC were 2.03±0.72 and 1.32±0.16 kg, respectively. IDC had lower live weight and growth rate compared to NSC at all ages for both sexes. These findings are supported by the results of Chen *et al.* (2009) and Kgwatalala *et al*. (2012) where they found that dwarf chicken had lower live weight than normal chicken at all ages. Kgwatalala *et al.* (2012) found 1869.47 and 1597.56g live weight of male and female dwarf chicken, respectively and 2270.19 and 1790.19g live weight of NSC at 20 weeks of age which is much higher than the present study at same age.

Yeasmin and Howlider (1998) observed that live weight of adult IDC and NSC hens were 1280 and 1347g which coincides with the present findings. The reductions of live weight for dwarf male and female chickens relative to their normal counterparts at 28 weeks of age were 12.91 and 16.91% respectively in this study. However, the available literature from Custodio and Jaap (1973), Guillaume (1976) and Horst *et al.* (1996) reported that body weight reduction varied from 8% to 40% in dwarf chicken genotype. Sex, homozygosity/heterozygosity of dwarf, breeds/varieties/strains and specific interactions with the background genome determines the degree of reduction. It is depicted from Table 3 that the growth rate of IDC was lower throughout the experimental period than the NSC which is supported with the findings of Yeasmin and Howlider (2013) and Njenga (2005). Highest growth rate was found in 9-12 weeks of age where lowest growth rate was found during 25-28 weeks of age both for IDC and NSC in the present study. The higher growth suppression at older ages agreed with Petersen *et al*. (1977). Yeasmin and Howlider (2013) also reported that higher daily weight gain of IDC and NSC was found from 5-18 weeks than the birds of 0-4 weeks of age.

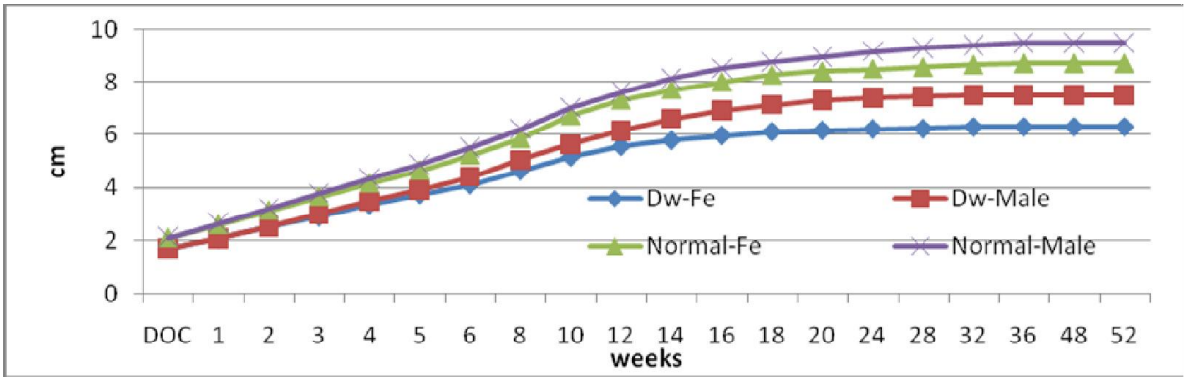

Figure1. Shank length of indigenous dwarf and normal shanked counterparts up to 52 weeks of age

Table 3.Growth performance of native dwarf and normal shanked chickens of Bangladesh[1]

Trait	Age (weeks)	Dwarf Chicken (Mean ± SE)		Normal shanked chicken (Mean ± SE)	
		Male	Female	Male	Female
Live weight (g/bird)	DOC	26.21±0.28 (117)	26.09±0.25 (138)	25.96±0.27 (94)	25.79±0.34 (87)
	4th	173.84±3.20 (114)	156.28±2.69 (135)	192.5±4.81 (90)	181.17±2.94 (84)
	8th	455.53±10.52 (114)	391.84±8.15 (134)	550.0±8.49 (90)	450.29±8.95 (84)
	12th	846.2±27.82 (30)	663.27±12.26 (83)	985.0±30.22 (39)	760.72±15.20 (36)
	16th	1191.4±30.84 (25)	851.33±13.68 (80)	1439.92±41.77 (25)	1004.83±16.97 (30)
	20th	1500.0±26.19 (25)	1020.39±10.88 (78)	1764.95±43.99 (20)	1212.32±23.32 (30)
	24th	1650±42.77 (25)	1067±9.38 (78)	1920±58.11 (15)	1271±18.01 (24)
	28th	1768±37.92 (20)	1096±7.71 (64)	2030±71.62 (15)	1319±16.45 (24)
Growth rate (g/day/bird)	0-4	5.26±0.11 (114)	4.65+0.09 (135)	5.96±0.16 (90)	5.49±0.10 (84)
	5-8	10.04±0.27 (114)	8.43±0.19 (134)	12.77±0.17 (90)	9.61±0.33 (84)
	9-12	13.75±0.33 (30)	9.88±0.09 (83)	15.74±0.72 (39)	11.09±0.16 (36)
	13-16	12.2±0.34 (25)	7.02±0.09 (80)	15.42±0.49 (25)	8.27±0.22 (30)
	17-20	10.41±0.49 (23)	6.24±0.10 (78)	11.60±0.72 (20)	6.94±0.44 (25)
	21-24	6.68±0.98 (20)	2.32±0.10 (70)	8.56±1.16 (15)	2.79±0.28 (24)
	25-28	4.21±0.40 (20)	1.43±0.10 (64)	3.93±0.77 (15)	1.71±0.20 (24)

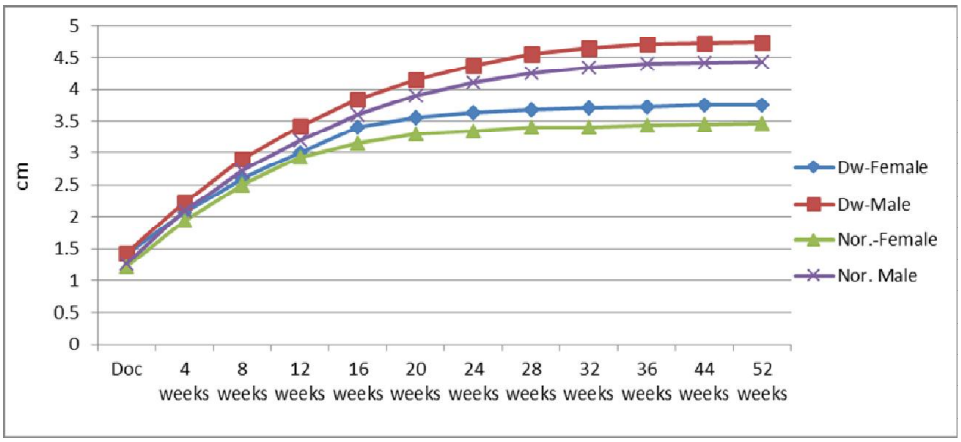

Figure 2. Shank circumference of indigenous dwarf and normal shanked counterparts up to 52 weeks of age

Shank length and Shank circumference

Shank length of IDC and NSC chicken up to 52 weeks of age is presented in Figure 1. It is showed that the initial growth of shank length was almost similar up to 4 weeks of age both male and female chicken. After that relatively lower growth of shank length was observed in IDC as compared to NSC up to 52 weeks of age. Remarkable differences of shank length were found between IDC and NSC as well as between sexes of both genotypes at all ages. These findings are partially supported by the reports of Kgwatalala *et al.* (2012) where they found dwarf

males and females had the shortest shanks. They found that sex had no significant influence on shank length of the IDC although the shanks of males were slightly longer than that of their female counterparts at all ages but significant differences in shank lengths between the normal and dwarf chicken (both sexes) at all ages were observed. Hussain *et al.* (1982) observed the shank length in the dwarf and normal layers to be 7 to 8 and 9.5 to 10.5 cm, respectively which is much closer to the present findings. Yeasmin and Howlider (1998) reported that normal shanked adult hen (7.7 cm) always had higher shank length than dwarf hen (5.5 cm) and differences increased at older ages (Yeasmin and Howlider; 2013). Raut *et al.* (1996) observed that shank length in male and female dwarfs at 20 weeks were 6.0±0.1 and 5.1±0.0 cm. Petersen *et al.* (1977) found that shanks in dwarfs were shorter by 9.6 and 20.9%, respectively than in normal chicken at 5 and 20 weeks. Chen *et al.* (2009) observed that the reduction of shank length in dwarf chicken reached 19.4 and 21.7% of shank length of the normal chicken at 10 and 20 weeks of age, respectively which supports the present study.

Shank circumference of IDC and NSC up to 52 weeks of age is presented in Figure 2. It is showed that relatively wider shank circumference was observed in IDC (both sexes) compared to NSC (both sexes) at all ages. Shank circumference was also recorded wider in male than female of both genotypes at all ages. Sarker *et al.* (2012) reported that shank circumferences of adult Aseel male and female chicken were 7.8 and 5.81 cm, respectively which were higher than the present findings. However, Sarker *et al.* (2014) reported that shank circumference of indigenous chicken was 4.12 cm which coincides with the present study. Breed/Type might be the major attributing factor for this variation.

Feed intake and Feed conversion efficiency for growing chicken

Feed intake and feed conversion efficiency of growing IDC and NSC is shown in Table 4. IDC consumed 11.13% less feed than NSC during 1-20 weeks which is lower than the findings of Yeasmin and Howlider (2013) where they found that IDC ate 16% less feed than NSC during 0-18 weeks. Penionzhkevich *et al.* (1976) reported that dwarf chickens ate 11.2 - 30.7% less than normal Starbro-4 between 9 and 65 weeks of age. Rashid *et al.* (2005) observed that higher feed intake was found in normal genetic group than their dwarf counterparts at all stages and they also reported that reduction in feed intake by dwarf birds ranged from 2.03 to 15.34 percent. Merat (1990) reported that reduction of feed consumption by dwarf birds was 22-25%.All of these observations support the present investigation. Table 4 shows that feed conversion was better during initial stage and gradually decreases at later ages. Feed conversion of IDC and NSC were 5.86 and 4.88 during 1-20 weeks which is slightly higher with the findings of Yeasmin and Howlider (2013) where they found that feed conversion of IDC and NSC was 4.4 and 3.9 during 0-18 weeks. Decuypere *et al.* (1991) reported that the feed efficiency of dwarf chicks during the growth period was poorer than in non-dwarf. Guillaume (1976) found that medium or heavy type chicken's feed to gain ratio was higher in dwarf birds than in normal siblings at all ages.

Table 4. Feed intake and feed conversion efficiency of growing indigenous dwarf and normal shanked chicken

Age (week)	Feed Intake (Mean ± SE)		Feed Conversion Efficiency (Mean ± SE)	
	IDC (g/bird/day)	NSC (g/bird/day)	IDC	NSC
1-4	13.07±0.21	15.5±0.58	2.62±0.05	2.65±0.08
5-8	31.96±0.49	36.50±0.58	3.43±0.06	3.24±0.04
9-12	50.96±0.69	56.25±0.43	4.58±0.08	4.51±0.22
13-16	63.71±0.48	71.25±1.12	7.89±0.11	5.96±0.07
17-20	67.79±0.77	76.50±1.18	12.81±0.29	8.18±0.09

Table 5. Production and reproduction potentialities of indigenous dwarf chicken of Bangladesh

Parameters		No. of observation	Mean ± SE
Hen day egg production (%)		52	37.43±1.14
Weight of 1st egg (g)		60	29.68±0.21
Egg Weight (g)		156	38.25±0.12
Feed intake (g)		52	69.57±0.32
Feed conversion ratio		52	4.58±0.12
Age at sexual maturity (days)		60	166.53±0.93
Weight at sexual maturity (g)		60	1093.2±10.27
Survivability (%)	0-8 weeks	255	97.25±0.35
	0-23 weeks	113	97.34±0.33
	24-75 weeks	75	96.00±0.44

Production and reproduction potentialities

Production and reproduction potentiality of IDC of Bangladesh under intensive management system is presented in Table 5. The average hen day egg production of IDC up to 75 weeks of age was recorded 37.43% which is within the range of the findings of Yeasmin and Howlider (1998) and Yeasmin *et al.* (2003) where they found hen day egg production of IDC were 33.50 and 43.26%, respectively. Rate of lay of native dwarf chicken of Kenya, Benin and Sudan was 36, 33 and 39.32 % respectively reported by Njenga (2005), Dakpogan *et al.* (2012) and Yousif and Eltayeb (2011), respectively. Findings of these above studies support the present investigation.

The average egg weight was found 38.25g in the present study which is supported by the findings of Yeasmin and Howlider (1998) and Yeasmin *et al.* (2003) where they obtained egg weight of IDC were 39.12 and 37.10g, respectively. Njenga (2005) and Dakpogan *et al.* (2012) found egg weight of IDC of Kenya and Benin were 38.1 and 39.1g, respectively which are almost similar to the current study. The average age at sexual maturity of IDC was recorded 166.53 days. This finding is in agreement with the findings of Yeasmin *et al.* (2003) and Yousif and Eltayeb (2011). The age at sexual maturity in Bangladeshi and Sudanese IDC were 170.60 and 163.90 days, respectively.

Decuypere *et al.* (1991) also reported a delayed sexual maturity in dwarfs (157 days) than in normal (152 days) layers. The average live weight and egg weight at sexual maturity of IDC was found 1093.2g and 29.68g, respectively. Dakpogan *et al.* (2012) found live weight at sexual maturity of IDC of Benin was 651.4±43g which was lower than present study. Hartmann (1976) got 34% lower mature body weight in heterozygous dwarf broiler hens than that of normal. Yeasmin *et al.* (2003) and Yousif and Eltayeb (2011) noted weight of 1st egg in Bangladeshi and Sudanese IDC were 29.37 and 29.03g which was almost similar to the present findings. The average feed intake and feed conversion efficiency (feed/egg weight) of IDC were found 69.57g and 4.58 respectively. Yeasmin and Howlider (1998) reported that feed intake and feed conversion efficiency of IDC were found 68.56g and 5.50 which are much closer to the present findings. Garces *et al.* (2001) reported that feed intake of normal feathered adult dwarf chicken in Mozambique was 66.2g/day. The efficiency of egg production can be improved by producing birds of smaller size which in turn consumes less feed without affecting egg production and egg size (Barot *et al.* 1996). Reduced feed consumption and their efficient conversion to eggs recorded in dwarf chicken agree with previous findings (Guillaume, 1976; Polkinghorne, 1976).

Survivability

Survivability of IDC up to 0-8 weeks and 9-23 weeks of age were 97.25% and 97.34% respectively. Survivability of laying dwarf chicken (24-75 weeks) was 95.24%. This result is almost similar to the findings of Rashid *et al.* (2005), where they found higher survival rate of dwarf genetic group (94.44-100%) up to 20 weeks of age. Garces *et al.* (2001) reported that livability (1-52 weeks) of IDC was 94.3% which coincides with present findings. 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.

Conclusion

Phenotypic characterization of indigenous dwarf chicken has established through the present investigation. The study revealed that dwarf chicken requires less feed without compromising egg production compared to available indigenous chicken of Bangladesh. However, this study gives some basic information about indigenous dwarf chicken which could be utilized to develop mini layer suitable for semi-scavenging system of Bangladesh.

Acknowledgements

The authors are grateful to HEQEP-AIF-CP10, UGC, Bangladesh for providing financial support and Department of Poultry Science, BAU for providing research facilities.

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