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Fertility and Hatchability of Eggs and Growth Performance of Mini-Incubator Hatched Indigenous Chicken in Rural Areas of Bangladesh

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ABSTRACT. *A study was conducted to investigate the performance of mini-hatchery of Indigenous chicken set under four villages of Jhenaigati upazilla of Sherpur district in Bangladesh. A total of 1070 eggs from Indigenous chicken were collected in 4 batches and 628 chicks were hatched artificially. Data were recorded on fertility, hatchability, body weight of chicks from week 1 (BWWK1) to week 17 (BWWK17). Least square means were obtained using SAS GLM and mean comparisons were performed with Duncan's Multiple Range Test. Fertility (%), hatchability (%) and mortality (%) of indigenous chicken eggs were 70.81, 77.52, 19.63, respectively. Comparable fertility and hatchability of Indigenous chicken eggs were found in this study. Body weight of male birds at third, fifth, seventh, eighth, eleventh, twelfth and thirteenth weeks were significantly higher than females as expected. Male birds were found heavier than the female birds in this study and artificially hatched birds grew better up to 11 weeks of age. The coal brooding system was superior to electric and natural brooding. Hand mixed feed gave better growth of birds than commercial feed and scavenging feed resources. Better growth of farm 2 was observed and replication of management system of farm 2 could be advised for other farmers to get a better growth. Batch, farm, brooding system and feeding system were found to be contributed to significant ($P<0.05$) differences in the body weight of birds at various weeks of their age. These results indicated that standardization of the management systems is required before implementation of mini hatcheries for incubation of Indigenous chicken eggs in rural areas of Bangladesh.*

Keywords: *Artificial hatching, fertility and hatchability, growth performance, indigenous chicken*

INTRODUCTION

Total poultry population of Bangladesh is approximately 307.46 million and among them chicken population is approximately 259.41 million in the year 2013-14 (MoFL, 2014). Total egg production in Bangladesh in the year 2013-14 was approximately 6745.28 million in number (MoFL, 2014). About 89 % of rural households rear poultry and contribute 20.8 % of the country's total egg and 37.3 % of meat (BBS, 2009). Indigenous chicken reared in rural areas still remains the main chicken genetic resource for the rural farmers. Indigenous poultry plays a key role in the home economy and its increased production has the potential to improve food security, assist in poverty alleviation and mitigate the adverse economic impacts for rural people (Dutta *et al*., 2013). Their special features are they are scavengers,

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high disease resistant, early maturity with higher fertility. In poultry enterprises with Indigenous chicken, the initial investment is low, the turnover is fast, the processing and marketing are simple (Ali, 2002). In Bangladesh, the meat and eggs of Indigenous chicken is highly preferred for its taste and suitability for special dishes resulting in even higher market prices for these chickens than their exotic counterpart (Islam *et al.,* 2009).

To increase the genetic potential of Indigenous chicken, planned breeding program is a demand of time. However, broodiness is one of the major characteristic of Indigenous chicken which causes less egg production. Artificial incubation system can minimize the problem of broodiness and also result in incubation of a large number of eggs at a time. As a result of reduced broodiness, egg production would be expected to be increased as well (Hossain, 2014). Mini-hatchery technology has proved to be successful under the socio-economic and climatic conditions of Bangladesh although hatchability rate has largely been found to be influenced by the quality, handling and conservation of fertile eggs before incubation and also viability of day old chicks (DOC) after hatching (Rota *et al*., 2010). With above rationale in view, the present study was conducted to reveal the fertility and hatchability of eggs and growth performance of mini-incubator hatched Indigenous chicken in rural areas of Bangladesh.

METHODOLOGY

The study was conducted in four rural villages namely Rangtia, Shalchura, Dudhnoi and Bangaon of Jhenaigati upazilla under Sherpur district of Bangladesh where UNEP-GEF-ILRI FAnGR Asia Project was in operation. Indigenous chicken eggs were collected from the community household members of the 'Indigenous Chicken Rearing Women Cooperative Society Ltd' for hatching using an artificial incubator under the said project. Data on fertility and hatchability of collected eggs and growth performance of 628 Indigenous chicks hatched using an artificial incubator in 4 batches during the period from August 2013 to June 2014 were recorded. Fertility was calculated on the basis of total eggs set whereas hatchability and mortality on hatching day (were calculated on the basis of total fertile eggs set. Fertility, hatchability and mortality were calculated using following formulae:

$$\text{Fertility (\%)} = \frac{\text{Total number of fertile eggs}}{\text{Total number of eggs set}} \times 100$$

$$\text{Hatchability (\%)} = \frac{\text{Total number of chicks hatched out}}{\text{Total number of fertile eggs}} \times 100$$

$$\text{Mortality (\%)} = \frac{\text{Total number of dead chicks}}{\text{Total number of fertile eggs}} \times 100$$

A locally made incubator with a capacity of 900 eggs was used for incubation. After hatching, two kinds of brooding system viz. electric and coal were used for birds of different batches. Birds were individually identified using leg and wing bands. Body weight of birds was taken by direct visit to farmer's houses using a top loading balance. Data on fertility, hatchability, body weight of birds in different weeks were available which were analyzed

using an unbalanced factorial design through SAS (2003). For analysis of body weight traits, the following general linear model was used:

$Y_{ijklm} = \mu + B_i + G_j + T_k + S_l + Vm + e_{ijklm}$

Where, Y_{ijkl} = Dependent variables (BWWK 1 ……. BWWK 17)

μ = Overall population mean for any of the said traits;

B_i = Effect of i^{th} sex (where i = 1, 2),

G_j = Effect of j^{th} batch (where j = 2, 3, 4 and 11),

T_k = Effect of k^{th} farm (where k = 1, 2 and 3),

S_l = Effect of l^{th} brooding system (where l = 1, 2)

V_m = Effect of m^{th} feeding system (where m = 1, 2, 3)

e_{ijklm} = Random residual error associated with Y_{ijklm} observation.

RESULTS AND DISCUSSION

Fertility and hatchability

A total of 1070 eggs of Indigenous chicken were collected and 612 chicks were hatched artificially in 4 batches. The average fertility, hatchability and mortality were 70.81 %, 77.52 % and 19.63 %, respectively (Table 1).

Table 1. Hatching performance of Indigenous chicken eggs

Parameter	Mean ± SE (n)
Fertility (%)	70.81±6.11 (1070)
Hatchability (%)	77.52±4.12 (784)
Mortality (%)	19.63±4.47 (784)

The average fertility and hatchability of Indigenous chicken eggs in artificial hatching with mini electrical incubator at rural area were 70.81 and 77.52 % respectively in the present study in Bangladesh. The hatchability of this study were similar to Kalita *et al*. (2009) in Assam (70 -81 %) and Portas *et al.* (2010) in Kenya (45 – 100 %, with mean hatchability of 81.5 %), Kirunda and Muwereza, (2011) in Uganda while the fertility was lower (82.8 %) than Mbuthia *et al.* (2007) in Kenya.

Effect of sex, batch, farm, brooding system and feeding system on body weight

The effect of various factors on body weights of Indigenous chicken at various weeks are presented in Table 2. Sex, significantly affected the body weights of chicken except at first and seventeenth week (BWWK1 and BWWK17). However, batch of chicks, farm, brooding system and feeding systems (scavenging, hand mix feeding and commercial feed supplying) have also significantly contributed to the differences in the growth performances of baby chicks of Indigenous chicken.

Table 2. Summary of analysis of body weights of Indigenous chicken

Trait	Effect of				
	Sex	Batch	Farm	Brooding system	Feeding system
BWWK 1	NS	*	*	*	*
BWWK 3	***	*	*	*	*
BWWK 5	***	*	*	*	*
BWWK 6	*	-	-	-	-
BWWK 7	***	*			*
BWWK 8	***	*	*	*	*
BWWK 9	**	*	*	*	-
BWWK 10	**	*	*	*	-
BWWK 11	***	*	*	*	-
BWWK 12	***	*	*	*	-
BWWK 13	***	*	*	*	*
BWWK 15	**	*	*	*	-
BWWK 17	NS	*	*	*	-

Sex: Male =1, Female =2
Batch: Incubator hatched = 1, 2, 3, 4, naturally hatched =11
Farm: 1(1st and 3rd batch), 2 (2nd and 4th batch), naturally hatched = 3,
Brooding system: Electric brooding = 1 (1st and 3rd batch), Coal brooding = 2 (2nd and 4th batch), Natural brooding = 3
Feeding system: Scavenging = 1 (3rd batch), Hand mix = 2 (1st, 2nd, naturally hatched), Commercial = 3 (4th batch)
NS= Not significant (p>0.05), *significant at p<0.05 **significant at p<0.01 and ***significant at p<0.001, - = not fitted

Body weight of Indigenous chicken

Sex

Sex of birds has affected growth performances at different ages (Table 3) and body weight of birds were higher in male than female (Fig. 1). However, Semakula *et al.* (2011) observed that males were superior ($P < 0.01$) to females in all body measurements. In chicken, body weights of males are substantially higher than females that could be due to the effective male growth hormones compared to female hormones (Singh *et al*., 1982). Khandoker (1993) observed on-station body weight of indigenous chickens at 8, 12 and 16 weeks of age averaged 186.5, 475.0 and 833.2 g, respectively which were much lower than the present findings. Also, Faruque *et al.* (2014) observed that male chicks were significantly ($p<0.001$) heavier in body weights at 8th, 12th and 16th weeks when compared to the females under on-station management conditions. These researchers observed body weights of 441.6, 776.8 and 1074.6 g, respectively at 8th, 12th and 16th week of age of Non-descript Deshi chicken. On the other hand, Kalita *et al*. (2009) reported body weight of day old chick as 24.89 g to 26.27 g and body weight of indigenous chicken at the age of 5 month as 740.00 to 862.25 g.

Batch

Birds of batch no. 4 were heavier between batch 3 and 4 up to BWWK5 but birds of batch 2 were heavier between batch 2 and 4 at BWWK7. However, body weights of chicks were higher in batch 2 among batch 1,2 and 11 during 9 to 11 weeks of age but higher body weights were recorded in batch 11 (naturally hatched) at 12 to 15 weeks of age while batch 2 performed better among these three (1,2 and 11) batches at 17 weeks of age. Lower

performance of batch 2 at 12 to 15 weeks might be due to lacking of one or more feed ingredients during feed mixing and again this batch performed better which might be due to correction of ingredients in feed formulation.

Farm

Between farm 1 and 2, chicks weight were higher in farm 2 up 8 weeks of age, again among farm 1, 2 and 3, farm 2 did better during 9 to 11 weeks of age of birds. However, among farm 1.2 and 3, farm 3 performed better during 13 to 15 weeks might be due to feed mixing problem in farm 2. However, at 17 weeks of age, higher body weights were reported in farm 2. So, it might be concluded that farm 2 performed better up to 11 weeks of age of birds and at 17 weeks of age of birds.

Brooding system

Coal brooding resulted better growth of birds compared to electric brooding during their early life (1-8 weeks), while also during 9-12 weeks of age of birds again coal brooding system did best compared to electric, coal and natural system. However, during 13 to 15 weeks of age natural brooding resulted better growth though at 17 weeks of age, coal brooding system again did best among all. As hand mix feeding system was practiced with coal brooding system, feeding system might have contributed to better performance of birds in coal brooding system. These results (Table 3) indicated that coal brooding was superior to electric and natural brooding when coal brooding was associated with hand mix feeding system.

However, according to Solomon (2007) the growth of the hay-box groups was slower than the electric groups during the first four weeks of brooding, but quickly acclimatized and compensated than the electric groups thereafter. There was no significant difference ($P>0.05$) between the electric and the hay-box groups in mortality from hatching to an age of 8 weeks and in rate of maturity as measured by the age at first egg.

Feeding system

Table 3 shows that feeding system 3 (commercial) was better than 1 (scavenging) and 2 (hand mixed) up to BWWK5 but BWWK7, BWWK8 and BWWK13, feeding system 2 (hand mixed feed) was superior to 3 (commercial feed) and 1 (scavenging). On the other hand, Lwesya *et al.* (2004) observed that chicks that were enclosed and fed for 8 weeks (wet season) had higher overall weight gains (222 ± 21.2 g) than enclosed for 6 weeks (both seasons) and chicks on control (un-supplement).

Table 3. Body weights of artificially incubated indigenous chicken at different ages (week)

Trait	Sex		Batch			Farm	
	Male	Female	2	3	4	1	2
BWWK 1	45.97±1.14[a]	38.44±0.86[b]	-	22.03±0.25[b]	50.18±0.53[a]	22.03±0.25[b]	50.12±0.53[a]
BWWK 3	129.36±2.83[a]	104.94±2.22[b]	-	68.20±1.69[b]	133.25±1.53[a]	68.20±1.69[b]	133.25±1.53[a]
BWWK 5	266.82±5.90[a]	213.92±4.79[b]	-	125.38±4.65[b]	267.79±2.98[a]	125.38±4.65[b]	267.79±2.98[a]
BWWK 6	377.78±10.97[a]	342.40±11.06[b]	360.77±8.10	-	-	-	360.77±8.10
BWWK 7	453.93±7.22[a]	390.72±4.98[b]	449.80±10.34[a]	-	412.07±4.90[b]	-	417.55±4.50
BWWK 8	429.62±23.49[a]	276.87±16.76[b]	528.73±12.27[a]	215.51±9.44[b]	-	215.51±9.44[b]	528.73±12.27[a]

Note: [abc]Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.
Sex: Male =1, Female =2
Batch: Incubator hatched = 1, 2, 3, 4, naturally hatched =11
Farm: 1(1st and 3rd batch), 2 (2nd and 4th batch), naturally hatched = 3

Trait	Brooding system		Feeding system		
	1	2	1	2	3
BWWK 1	22.03±0.25[b]	50.12±0.53[a]	22.03±0.25[b]	-	50.12±0.53[a]
BWWK 3	68.20±1.69[b]	133.25±1.53[a]	68.20±1.69[b]	-	133.25±1.53[a]
BWWK 5	125.38±4.65[b]	267.79±2.98[a]	125.38±4.65[b]	-	267.79±2.98[a]
BWWK 6		360.77±8.10	-	360.77±8.10	-
BWWK 7		417.55±4.50	-	449.80±10.35[a]	412.07±4.90[b]
BWWK 8	215.51±9.44[b]	528.73±12.27[a]	215.51±9.44[b]	528.73±12.27[a]	-

Note:[abc]Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.
Brooding system: Electric brooding = 1 (1st and 3rd batch), Coal brooding = 2 (2nd and 4th batch), Natural brooding = 3
Feeding system: Scavenging = 1 (3rd batch), Hand mix = 2 (1st, 2nd, naturally hatched), Commercial = 3 (4th batch)

Table 3. Body weights of artificially incubated indigenous chicken at different ages (week) (contd.)

Trait	Sex		Batch				Farm		
	Male	Female	1	2	3	11	1	2	3
BWWK 9	470.58 ±23.44[a]	394.75± 23.54[b]	275.00±8.35[c]	602.30 ±12.05[a]	-	346.67 ±17.64[b]	275.00 ±8.35[c]	602.30 ±12.05[a]	346.67±17.63[b]
BWWK 10	546.38 ±17.81[a]	345.59± 13.16[b]	382.18±11.46[c]	637.69 ±26.41[a]	-	530.90 ±24.80[b]	382.18 ±11.46[c]	637.69 ±26.41[a]	530.90±24.80[b]
BWWK 11	614.60 ±17.01[a]	489.48± 19.47[b]	438.04±13.99[c]	663.47 ±16.19[a]	-	629.38 ±29.30[b]	438.04 ±13.99[c]	663.47 ±16.19[a]	629.38±29.30[b]
BWWK 12	641.62 ±20.85[a]	413.45± 12.31[b]	482.55±16.16[b]	-	-	741.33 ±22.55[a]	482.55 ±16.16[b]	-	741.33±22.55[a]
BWWK 13	693.72 ±21.11[a]	462.77± 21.84[b]	611.36±22.13[c]	785.81 ±25.51[b]	396.92 ±15.55[d]	788.93 ±23.37[a]	444.10 ±15.79[c]	785.82 ±25.51[b]	788.93±23.37[a]
BWWK 15	833.94 ±24.23[a]	650.77± 32.29[b]	640.00±34.93[c]	763.33 ±22.23[b]	-	899.22 ±37.93[a]	640.00 ±34.93[c]	763.33 ±22.23[b]	899.22±37.93[a]
BWWK 17	1093.10±58.45[a]	507.00± 20.74[b]	507.00±20.74[c]	1151.30±68.56[a]	-	870.00 ±25.56[b]	507.00 ±20.74[c]	1151.30 ±68.56[a]	870.00±25.56[b]

Note:[abc]Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.
Sex: Male =1, Female =2
Batch: Incubator hatched = 1, 2, 3, 4, naturally hatched =11
Farm: 1(1st and 3rd batch), 2 (2nd and 4th batch), naturally hatched = 3,
Table 3 Body weights of artificially incubated Indigenous chicken at different ages (week) (contd.)

Trait	Brooding system			Feeding system	
	1	2	3	1	2
BWWK 9	275.00±8.35[c]	602.30±12.05[a]	346.67±17.64[b]	-	430.27±16.96
BWWK 10	382.18±11.46[c]	637.69±26.41[a]	530.90±24.80[b]	-	472.17±15.86
BWWK 11	438.04±13.99[c]	663.47±16.19[a]	629.38±29.30[b]	-	554.63±14.03
BWWK 12	482.55±16.16[b]	-	741.33±22.55[a]	-	541.36±18.99
BWWK 13	444.10±15.79[c]	785.82±25.51[b]	788.93±23.37[a]	396.92±15.55[b]	747.93±16.68[a]
BWWK 15	640.00±34.93[c]	763.33±22.23[b]	899.22±37.93[a]	-	756.29±21.63
BWWK 17	507.00±20.74[c]	1151.30±68.56[a]	870.00±25.56[b]	-	853.88±54.57

Note: [abc]Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.
Brooding system: Electric brooding = 1 (1st and 3rd batch), Coal brooding = 2 (2nd and 4th batch), Natural brooding = 3
Feeding system: Scavenging = 1 (3rd batch), Hand mix = 2 (1st, 2nd, naturally hatched), Commercial = 3 (4th batch)

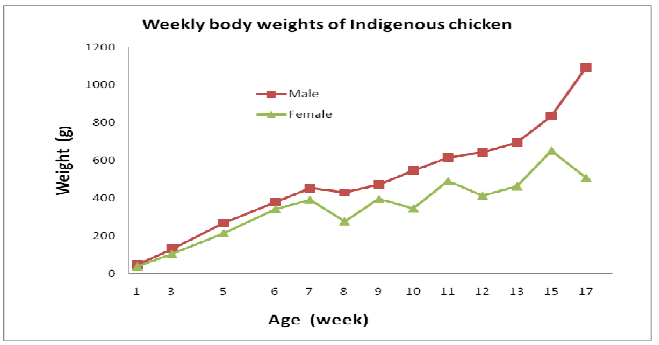

Fig. 1. Body weight of male and female indigenous chicken in rural areas

CONCLUSION

Comparable fertility and hatchability of Indigenous chicken eggs were found in this study. Male birds were found heavier than the female birds in this study and artificially hatched birds grew better up to 11 weeks of age. The coal brooding system was superior to electric and natural brooding. Hand mixed feed gave better growth of birds than commercial feed and scavenging feed resources. Farm 2 performed better up to an age of 11 weeks of Indigenous chicks. Hence, it might be concluded that management system of farm 2 was better than others to rear baby chicks up to 11 weeks of age and all farmers could follow the management system of farm 2 and electric incubator could be used where electricity is available at rural villages.

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