J. Life Earth Sci., Vol. 5: 63-67, 2010 **ISSN 1990-4827**

EGG QUALITY TRAITS OF INDIGENOUS, EXOTIC AND CROSSBRED CHICKENS (*Gallus domesticus* L.) IN RAJSHAHI, BANGLADESH

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Abstract: This study was aimed at investigating the external and internal egg quality traits along with their correlation values of an indigenous (*Deshi*), three exotics (Cobb 500 of Broiler, Fayoumi, and RIR) and a crossbred (*Sonali* derived from RIR♂× Fayoumi♀) chicken breeds available in Rajshahi. From a total of 50 eggs (5 breeds × 10 replicates each), the external quality traits such as gross egg weight (EW), egg length (L), egg width (W), egg volume (EV), shell weight (SW), shell ratio (SR) and egg shape index (ESI), and the internal quality traits like yolk weight (YW), albumen weight (AW), yolk ratio (YR) and albumin ratio (AR) were determined. Results showed that highly significant differences exist for both external and internal egg quality traits between the genetic groups of chicken (P<0.001). Even though RIR showed the highest EW and EV and Fayoumi had the lowest for both traits, AR was in the sequence of Cobb 500 > RIR> Indigenous> Fayoumi> *Sonali*. Phenotypic correlations among the egg quality traits revealed that EV was not significantly correlated with EW except for Sonali (P<0.001). The association between EW and ESI was negative in all the chickens except *Sonali*. However, EW was significantly correlated with the AW in RIR (P<0.001), Cobb 500 (P<0.01) and *Sonali* (P<0.01). Moreover, the EW was significantly correlated with YW only in Fayoumi and RIR (P<0.05). In view of the cholesterol, fat and antioxidant contents of the hen's egg, a higher AR is healthier than a higher YR. The present findings therefore suggest that Cobb 500, RIR and Indigenous eggs are healthier than Fayoumi and *Sonali* eggs that contain higher YR.

Key words: Egg quality traits, phenotypic correlation, Indigenous, exotic and crossbred chickens

mvivsk: GB M‡elYwU ivRkvnx‡Z mnRjf¨ GKwU †`kx, wZbwU we‡`kx Ges GKwU msKi Rv‡Zi giMxi ewn¨K I Avf¨šixY wW‡gi ˆewkó¨ wb‡q Kiv n‡q‡Q| †gvU cÂvkwU (5wU RvZ × cwZwU i 10wU †iwc‡Kkb) wW‡gi ewn¨K ˆewkó¨ †hgb IRb, ^`N¨, c¯—, AvqZb, †Lvmvi IRb, †Lvmvi AbcvZ Ges AvKwZ mPx I Avf¨šixY ˆewkó¨ †hgb Km‡gi IRb, mv`v As‡ki IRb Ges Km‡gi AbcvZ I mv`v As‡ki AbcvZ wbYq Kiv nq| M‡elYvq †`Lv hvq †h, wW‡gi ewn¨K I Avf¨šixY ˆewkó¨ ¸wji cv_K¨ giMxi †R‡bwUK RvZ Abmv‡i AZ¨š ZvrchcYfv‡e we`¨gvb| hw` I RIR wW‡gi IRb I AvqZb me©bg cwijw¶Z n‡q‡Q, Z_wc mv`v As‡ki AbcvZ Cobb 500 > RIR > †`kx > Fayoumi > *Sonali* GB chvqµ‡g cvIqv hvq| *Sonali* Qvov Ab¨vb¨ Rv‡Zi giMx‡Z wW‡gi AvqZb I IRb ZvrchcYfv‡e m¤úwKZ| Avevi †mwbwj Qvov Ab¨vb¨ mKj Rv‡Zi giMx‡Z wW‡gi IR‡bi m‡½ wW‡gi AvKwZ mPxi FYvZ¥K m¤úK i‡q‡Q| hv†nvK, RIR, Cobb 500 Ges Sonali giMx‡Z wW‡gi IRb Ges mv`v As‡ki IRb ZvrchcYfv‡e m¤úwKZ| ZQvov, Fayoumi Ges RIR wW‡gi IRb Km‡gi IR‡bi mv‡_ ZvrchcYfv‡e m¤úwKZ| wW‡gi †Kv‡j‡÷ij, Pwe I G‰U-Aw·‡WvU Dcv`v‡bi wfwË‡Z D"PZi mv`v As‡ki AbcvZ D"PZi Km‡gi Abcv‡Zi †P‡q ¯v¯—m¤§Z| eZgvb djvd‡ji wfwË‡Z ejv hvq †h, Cobb 500, RIR I †`kx giMxi wWg Fayoumi I *Sonali* giMxi wW‡gi (th¸‡jv‡Z D"PZi Km‡gi AbcvZ we`¨gvb) †P‡q AwaK ¯v¯—m¤§Z|

Introduction

The knowledge and information on the structure of egg and its various parameters are essential for an understanding of egg quality, fertility, embryo development and diseases of the poultry. Age, feed, protein levels and temperature are some of the factors that affect egg size in chickens (Banerjee 1992). Economically important egg quality traits such as weight, size, yolk and albumen contents are quantitative traits with continuous variability (Das 1994). The relationship between weight, length and width of eggs has been reported by Danilov (2000) who also noted the proportion of yolk, albumen and shell that contribute to the egg weight increases with hen's age, reaching a plateau by the end of the laying cycle. Thus egg weight is one of the important phenotypic traits which influence egg quality and reproductive fitness of the chicken parents (Islam *et al*. 2001; Farooq *et al*. 2001).

It is obvious that beneficial egg quality traits are of immense importance to poultry breeding industries (Bain 2005). In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of the hen (Finkler et al. 1998; Onagbesan et al. 2007). Subsequently, effects of feed (Adedeji et al. 2008; Shapira 2010), hormone (Guzel et al. 2009) and housing system (Pohle and Cheng 2009; Sossidou and Elson 2009; Wang et al. 2009) on egg composition and its quality have been investigated.

Previous studies with egg quality traits of various chicken breeds by Finkler et al. (1998), Yeasmin and Howlider (1998), Islam (2006), Silversides et al. (2006), Chatterjee et al. (2006; 2007), Nahar et al. (2007), Adedeji et al. (2008), Niranjan et al. (2008), Olawumi and Ogunlade (2008), Wang et al. (2009), Boneckmp et al. (2010), Jones et al. (2010) and Momoh et al. (2010) revealed results that are important to poultry breeders.

The present study was analyze genotype and statistical measures of some vital external and internal egg quality traits of the Indigenous (Deshi), exotic and crossbred chickens and report the advantages of the most suitable hen's eggs that are available in and around Rajshahi.

Materials and Methods

Collection of the eggs: A total of 50 fresh eggs (5 breeds × 10 replicates each) were collected from an Indigenous (non-descriptive, *Deshi*), three exotics (Cobb 500, Fayoumi and Rhode Island Red) and a crossbred (*Sonali* = RIR♂ × Fayoumi♀) breeder hens. Indigenous hens were reared on scavenging system at a domestic house while Cobb 500, Fayoumi, RIR and *Sonali* hens were raised on deep litter system at private owned Ali, Aljami, Taki and United poultry farms, respectively situated in Rajshahi City Corporation areas. However, stocking density of different breeds at the farms were 500, 5500, 16000 and 6000 respectively.

External and internal egg quality traits: For this study seven external egg quality traits *viz*. gross egg weight (EW) in g, egg length (L) in cm, egg width (W) in cm, egg volume (EV) in cm^3, shell weight (SW) in g, shell ratio (SR) in %, and egg shape index (ESI) in %, and four internal egg quality traits *viz*. yolk weight (YW) in g, albumin weight (AW) in g, yolk ratio (YR) in % and albumen ratio (AR) in % were taken into account. The eggs were numbered first and then weighed on an electronic balance to determine their weights. Subsequently, L and W of the eggs were measured by slide calipers and the EV was determined using the formula, EV = $\pi \times L \times W^2/ 6$ (cm^3). Each egg was broken on a table and its contents poured into a plate. Then the yolk was separated from the albumen with the help of a spoon and weighed while the AW was calculated by subtracting YW and SW from the gross EW [*i.e.* AW = EW- (YW + SW)]. On the basis of the above measurements, the remaining egg quality traits were obtained using the following formulae (Olawumi and Ogunlade 2008): Shell ratio, SR (%) = SW/EW × 100; egg shape index, ESI (%) = W/L × 100; yolk ratio, YR (%) = YW/EW × 100; and albumen ratio, AR (%) = AW/EW × 100. Moreover, the phenotypic associations between the relevant external and internal egg quality traits were determined by Karl Pearson's product moment co-efficient of correlation (r).

Statistical analyses: Mean, standard deviation (SD), analysis of variance (ANOVA), least significant differences (LSD) and co-efficient of correlation values (r) were computed using the SPSS (version 11.0 for Windows). Data on various external and internal egg quality traits were subjected to these statistical procedures to detect the significance of difference between the genetic groups of chicken under study.

Results and Discussion

External egg quality traits: Data on external egg quality traits (Table 1) revealed that the gross EW differed significantly among the genetic groups of chickens ($F_{4,45}$ = 24.40; P<0.001) where RIR had the highest and Fayoumi the lowest values for the trait. However, EW of the Indigenous and Fayoumi did not differ statistically. The EV of the experimental chickens, derived from their egg length and width parameters, also showed highly significant difference between breeds ($F_{4,45}$ = 39.86; P<0.001), where RIR and Fayoumi had the highest and the lowest volumes, respectively. Similar to EW, difference in EV between Indigenous and Fayoumi was not significant. The EV between Cobb 500 and RIR and that between Cobb 500 and *Sonali* also did not differ significantly. Although the SW differed significantly between the genetic groups ($F_{4,45}$ = 4.65; P<0.01), the SR of the chickens did not differ statistically ($F_{4,45}$ = 1.06; P>0.05). Notably, the SR values of the Indigenous, Broiler and Fayoumi were similar which differed significantly from both *Sonali* and RIR. However, in apparent contrast to the egg phenotypes, the present results clearly demonstrate that the egg shape index (ESI) of the five chicken breeds was in the following order: Fayoumi> Indigenous> RIR> *Sonali* > Cobb 500 (Fig. 1).

It is an established fact that the weight of an egg is a direct proportion of albumen, yolk and shell that it contains and this varies significantly between strains of hen (Pandey *et al*. 1986). This is due to the significant effect of chicken genotype on specific gravity of the eggs as reported by Yeasmin and Howlider (1998), Nahar *et al*. (2007), Onagbesan *et al*. (2007), Jones *et al.* (2010) and Momoh *et al*. (2010). In contrast to these findings, however, weights of egg, yolk and egg shell did not vary between Plymouth Rock, RIR and their hybrids (Garcaoa-Lapez *et al*. 2007), and egg mass of the brown heavy breed and the white light breed laying hens was not found to differ significantly (Bonekamp *et al*. 2010). The present results on egg weight conform to those reported earlier by Islam (2006), Chatterjee *et al.* (2006; 2007), Niranjan *et al*. (2008), Olawumi and Ogunlade (2008) and Jones *et al*. (2010). As regards the other external egg traits, age and strain of the chicken (Finkler *et al*. 1998; Yeasmin and Howlider 1998; Silversides *et al*. 2006), feed (Adedeji *et al*. 2008;

Table 1. Descriptive statistics of egg quality traits in different genetic groups of chicken in Rajshahi

Traits (N= 10)	IND	BRO	FAY	RIR	SON
Age (month)	6.22± 1.24	1.10± 0.07	1.92± 1.19	18.9± 0.61	1.80± 1.16
External egg quality traits					
Egg weight (g)	40.04± 2.52^{d}	46.80± 3.55^{b}	39.83± 2.66^{d}	56.50± 7.22^{a}	43.80± 4.24^{c}
Egg length (cm)	4.83± 0.35^{c}	5.69± 0.20^{a}	4.77± 0.44^{c}	5.78± 0.29^{a}	5.46± 0.18^{b}
Egg width (cm)	3.71± 0.15^{c}	4.22± 0.08^{ab}	3.72± 0.23^{c}	4.43± 0.13^{a}	4.12± 0.12^{b}
Egg volume (cm^3)	34.99± 5.72^{c}	53.09± 3.66^{ab}	34.95± 7.35^{c}	59.52± 6.26^{a}	48.60± 4.06^{b}
Shell weight (g)	6.41± 1.97^{c}	6.80± 1.23^{c}	6.14± 2.02^{c}	9.10± 2.23^{a}	7.90± 1.29^{b}
Shell ratio (%)	16.10± 5.07^{a}	14.54± 2.35^{a}	15.53± 5.18^{a}	16.13± 3.62^{a}	18.13± 2.98^{a}
Internal egg quality traits					
Yolk weight (g)	14.65± 3.48^{a}	9.60± 1.58^{b}	14.88± 4.01^{a}	11.20± 2.39^{b}	16.40± 2.41^{a}
Albumin weight (g)	18.92± 1.66^{c}	30.40± 3.24^{b}	18.51± 1.50^{c}	36.10± 4.46^{a}	19.50± 4.40^{c}

IND = Indigenous; BRO = Broiler (Cob 500); FAY = Fayoumi; RIR = Rhode Island Red; SON = *Sonali*; Values are mean±SD with different superscript letters for a parameter in the same row differ significantly by LSD at P<0.05.

Table 2. The phenotypic correlations between external quality traits of eggs from five genetic groups of chickens in Rajshahi.

Breeds	EW *vs.* EV	EW *vs.* SW	EW *vs.* ESI	SW *vs.* SR
Indigenous	0.48ns	-0.10ns	-0.17ns	0.97***
Cob 500	0.26ns	0.37ns	-0.21ns	0.90***
Fayoumi	0.43ns	-0. 2ns	-0.21ns	0.97***
RIR	0.62ns	0.47ns	-0.49ns	0.85**
Sonali	0.93***	0.24ns	0.05ns	0.82**

EW = Egg wt.; EV = Egg volume; SW = Shell wt; ESI = Egg Shape index; SR = Shell ratio; vs. = versus; ns = not significant; ** = P<0.01 and *** = P<0.001.

Table 3. The phenotypic correlations between internal quality traits of eggs from five genetic groups of chicken in Rajshahi.

Breeds	YW vs AW	YW vs YR	YW vs AR	AW vs AR
Indigenous	-0.31ns	0.97***	-0.76**	0.75*
Cob 500 -	0.20ns	0.89***	-0.70*	0.72*
Fayoumi	-0.51ns	0.98***	-0.87***	0.76*
RIR	0.65*	0.77**	-0.24ns	0.11ns
Sonali	-0.39ns	0.82**	-0.60ns	0.95***

YW = Yolk weight; AW = Albumin weight; YR = Yolk ratio; AR = Albumin raio; vs. = versus; ns = not significant; * = P<0.05; ** = P<0.01 and *** = P<0.001.

Table 4. The phenotypic correlations between external and internal quality traits of eggs from five genetic groups of chicken in Rajshahi

Breeds	EW vs YW	EW vs AW	EW vs YR	EW vs AR	ESI vs YW	ESI vs AW
IND	0.59ns	0.45ns	0.37ns	-.25ns	-0.21ns	0.27ns
BRO	0.28ns	0.82**	-.19ns	0.19ns	-0.38	0.10ns
FAY	0.66*	0.13ns	0.49ns	-.55ns	0.001ns	-.15ns
RIR	0.72*	0.96***	0.12ns	-.17ns	-0.46ns	-.44ns
SON	0.12ns	0.70*	-.42ns	0.52ns	-.006ns	-.13ns

IND = Indigenous; BRO = Broiler (Cob 500); FAY = Fayoumi; RIR = Rhode Island Red; SON = *Sonali*; EW = Egg wt.; AW = Albumin wt.; YR = Yolk ratio; AR = Albumin ratio; ESI = Egg Shape index; vs. = versus; ns = not significant; * = P<0.05; ** = P<0.01 and *** = P<0.001.

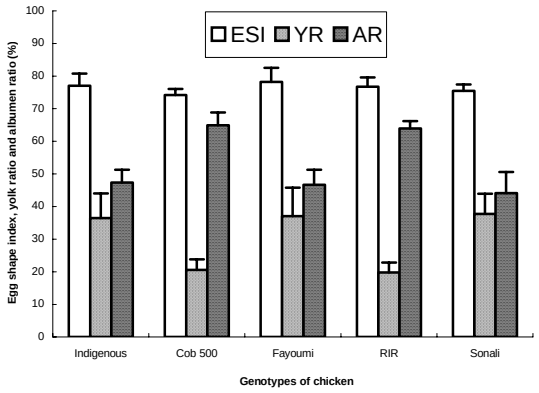

Fig. 1. Estimated egg quality traits *viz*. egg shape index (ESI), yolk ratio (YR) and albumin ratio (AR) from five genetic groups of chicken in Rajshahi

Shapira 2010) and housing system (Pohle and Cheng 2009; Sossidou and Elson 2009; Wang *et al*. 2009) have been designated to cause significant variations. This probably has exactly been the case for variations in EV, SW, SR and ESI values obtained for the Indigenous, exotic and crossbred chickens of the present study.

Internal egg quality traits: All the internal egg quality traits *viz*., the YW ($F_{4,45}$ = 9.48; P<0.001), AW ($F_{4,45}$ = 59.62; P<0.001), YR ($F_{4,45}$ = 22.39; P<0.001) and AR ($F_{4,45}$ = 52.03; P<0.001) exhibited highly significant differences between the breeds (Table 1). Contrary to the apparent volume of the eggs, YW was the highest in *Sonali* and the lowest in RIR whereas AW was the highest in RIR and the lowest in Fayoumi. In terms of the YR, *Sonali* showed the highest, followed by Fayoumi, Indigenous, Cobb 500 and RIR; while the AR showed the following sequence: Cobb 500> RIR> Indigenous> Fayoumi> *Sonali* (Fig. 1).

Among the internal egg quality parameters, YW, YR, AW and AR are very important from nutritional (Bain 2005) and cholesterol content (Abdullahi *et al.* 2003; Sparks 2006) viewpoints. Values for these traits reported in the present study are comparable with those obtained by Yeasmin and Howlider (1998), Chatterjee *et al*. (2007), Olawumi and Ogunlade (2008), Wang *et al*. (2009) and Momoh *et al*. (2010) for chickens of Bangladesh, Andaman (India), Nigeria, China and Nigeria, respectively. In contrast, however, EW, YW and SW in Plymouth Rock, RIR and their hybrids (Garcaoa-Lapez *et al*. 2007) and YW and yolk-albumen ratio in Isa Brown (Adedeji *et al*. 2008) did not vary significantly.

Associations between various egg quality traits: As presented in Table 2, all chicken breeds showed insignificant correlations for external egg quality traits between EW and SW, EW and SI, and EW and EV excepting *Sonali* ($r = 0.93$; $P<0.001$). However, highly significant correlations were found to exist between SW and SR for all genetic groups of chicken under study. The correlation values for internal egg quality traits between YW and AW were insignificant for all breeds except RIR ($r = 0.65$; $P<0.05$) but those between YW and YR were highly significant for all genetic groups. The YW and AR showed significant correlations in the Indigenous, Cobb 500 and Fayoumi, while AW and AR showed significant correlations in all chickens except RIR (Table 3). The phenotypic associations between external and internal egg quality traits in the chicken breeds revealed some interesting findings (Table 4), where all the correlation values were statistically insignificant except those between EW and YW for Fayoumi ($r = 0.66$: $P<0.05$) and RIR ($r = 0.72$; $P<0.05$); and those between EW and AW for Cobb 500 ($r = 0.82$; $P<0.01$), RIR ($r = 0.96$; $P<0.001$) and *Sonali* ($r = 0.70$; $P<0.05$).

As regards the significant correlations between various external and internal egg quality traits, the present findings on Indigenous, exotic and crossbred agree with Isa Brown layers (Adedeji *et al*. 2008; Olawumi and Ogunlade 2008) and the local chickens of Nigeria (Momoh *et al*. 2010). Moreover, the negative correlation values between EW and SI as well as YW and AR of the present study agree with Pohle and Cheng (2009) and Momoh *et al*. (2010), but disagree with Olawumi and Ogunlade (2008), who obtained significant correlation between YW and AR.

Since hen's eggs contribute substantially to the human diet, their nutritional profile including fat and antioxidant contents in particular are important because yolk mass is related to the amount of cholesterol (Abdullahi *et al*. 2003; Sparks 2006). Moreover, egg molecules represent a major source of active principles usable by medical, pharmaceutical, cosmetic as well as biotechnological industries (Anton *et al.* 2006). However, together with antioxidants, egg molecules may be beneficial against cardiovascular disease risks that are associated with oxidative stress, endothelial dysfunction, dyslipidaemia, and inflammatory processes in diabetics (Shapira 2010). Significantly higher AR values in Broiler, RIR and Indigenous eggs compared to those in Fayoumi and Sonali (having higher YR values) indicate that the former genotypes would be nutritionally potential and healthier than the later ones, and therefore, can be recommended as better layer varieties of chicken suitable for rearing and marketing in Rajshahi. For improving these layers, however, systematic breed evaluation and breeding, accompanied by effective feeding, management and disease control programmes at farm levels should be emphasized.

Conclusion

External and internal egg quality traits indigenous (*Deshi*), Cobb 500 breed of Broiler, Fayoumi, RIR *Sonali* chicken breeds available in Rajshahi were studied. Results suggest that Cobb 500, RIR and *Deshi* eggs are healthier than Fayoumi and *Sonali* eggs that contain higher yolk ratio.

Acknowledgements: This forms a part of MSc thesis by Ripon Kumar Dutta. The authors would like to thank numerous poultry sellers and growers in the study areas for their co-operation and sincere help in providing information required for this research. Laboratory technicians also deserve special mention for their assistance in collecting egg quality traits.

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Manuscript received on 25 October 201 and revised on 14 December 2010.