A Study on Phenotypic and Reproductive Characteristics of layer chicken in commercial farm of Fatikchari upazilla, Chattogram

A production report submitted in partial fulfillment of the requirement for the Degree of Doctor of Veterinary Medicine (DVM)

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Session: 2017-18

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A Study on Phenotypic and Reproductive Characteristics of layer chicken in commercial farm of Fatikchari upazilla, Chattogram,Bangladesh.

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Statements of Author

I, **Rumi akter**, hereby declare that I have completed all tasks and provided the information in this report. The data was gathered through publications, websites, and other sources both domestically and abroad. All citations have been properly acknowledged. As a result, I am entirely responsible for gathering, combining, preserving, and publishing all of the data that has accumulated in this report.

The Author
August ,2023

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List of Abbreviation

CVASU	Chattogram Veterinary and Animal Sciences University
DVM	Doctor of Veterinary medicine
RIR	Rod Island Red
%	Percentage
±	Plus minus

ACKNOWLEDGEMENT

Abstract

The area of Chattogram is well known for its chicken farms. Here, the number of commercial layer farms increases daily. Therefor, a study was conducted in commercial layer farm in Fatikchari under Chittagong district to observe the phenotypic and reproductive characteristics of commercial layer chicken in this area.

A study was conducted for a period of 1 month 10 days (from 16th April to 25th May, 2023) at 6 unions (Nanupur, Baktapur, Samitirhat, Paindanga, Kanchan nagar, Jafatnagar) Fatikchhari, Chattogram. A random sample of 125 layer chickens was chosen from several commercial layer farms. Then their phenotypic and reproductive characteristics werer studied by collecting data.

There was found 88% Red brown RIR, 84% Fayoumi and 92% Sonali chicken. Their shank color had found variation like Fayoumi had 100% Black shank, RIR and Sonali both had 100% yellowish shank RIR produced 56±2.645 gm egg whereas Fayoumi and Sonali produced average 45.2±0.836 gm and 48±1.581 gm. That means RIR produced heavier eggs than Fayoumi and Sonali chickens. Moreover, Fayoumi produced 100% white while RIR and Sonali egg color was 100% brown. Again mean egg length of Fayoumi, RIR and Sonali chickens were 4.0±1.00 cm, 6.04±0.181 cm and 5.28±0.258 cm. That means,RIR was showed highest egg length among three breed. The average egg volume of Fayoumi, RIR and Sonali chickens were 33.34±1.665 cm^3, 63.06±6.104 cm^3, 44.82±5.044 cm^3. Egg volume of RIR was higher than Sonali and Fayoumi. The average Shell weight of Fayoumi, RIR and Sonali chickens were 6.5±0.598 gm, 10.62±0544 gm and 8.14±0.288 gm. Shank length of Fayoumi, RIR and Sonali chickens were 4.06±0.114 cm, 9.1±0.158 cm and 3.94±0.114 cm. Again Beak length of Fayoumi, RIR and Sonali chickens were 2.01±0.013 cm, 2.0±0.071 cm and 1.99±0.023 cm. Neck length of Fayoumi, RIR and Sonali chickens were 13.34±0.882 cm, 14.38±0.593 cm and 13.38±1.103 cm. The result of three breeds nearly similar. No difference was found in egg shell color of RIR and Sonali layers, the egg shell was brown in color while Fayoumi egg was white. It may be concluded that three genetic groups of chicken had physical variation for both qualitative and quantitative traits.

Keywords: RIR, Fayoumi ,Sonali breed; Phenotypic characters ,Egg quality traits, External egg quality traits correlation.

Chapter 1
Introduction

The poultry industry in Bangladesh is a significant contributor to the national economy and plays a critical role in maintaining food security, enhancing the nutritional quality of the country's rural residents and bolstering the national economy. Additionally, chicken farming helps to fight poverty.

Poultry meat and eggs make up about 20% of the protein eaten in developing nations (Alders and Pym, 2009). In the majority of situations, young individuals operate broiler and layer farms. As though raising layers on a large scale would be more profitable and money-making than raising broilers and the birds could also be sold as meat after producing eggs. In Bangladesh nowadays, the following two primary poultry farming methods are widespread: Commercial poultry production, which keeps birds entirely confined. Additionally, traditional scavenging or semi-scavenging poultry production is still practiced (Das *et al*., 2008).

The sole purpose for which layer chickens are created and employed commercially is egg production. Leghorn, Minorca and Fayoumi are some prominent breeds of layers, as well as the strains ISA brown, Star cross, Lohman, and others. There are numerous breeds of layer chicken in Bangladesh. The most prevalent breeds in commercial layer farms include Sonali (crossbreed), Fayoumi and Rod Island Red (RIR).These breeds are occasionally referred to as dual breeds (egg and meat). Despite recent challenges, Bangladesh's industrial-scale commercial poultry production is expanding rapidly and is anticipated to significantly contribute to the nation's economic development (Das *et al*., 2008).

In addition to the native chicken, chickens are also raised in rural areas for the production of eggs and meat, although not for commercial purposes. With high levels of morphological and phenotypic variety and high fitness potentialities under natural conditions, the indigenous chicken of Bangladesh makes up around 90% of the total chicken population (Bhuiyan, 2002).

Commercial layer chicken performs better than native chicken in terms of egg production (M. Saiful *et al*. 2010).The main effects of the genotype on egg weight and eggshell properties are these.

According to several research (Halaj and Grofk 1994; Ledvinka *et al.* 2000; Leyendecker *et al.* 2001a; Vits *et al.* 2005) dark hens lay heavier eggs than white hens do. Age is another element that influences egg weight in addition to genotype. As a result, egg weight is a significant phenotypic characteristic that affects egg quality and the ability of the chicken parents to reproduce (Islam *et al.* 2001; Farooq *et al.* 2001). With breed variety, there is also variation in the phenotypic character. There were no research facility based on phenotypic and reproductive characters of Fayoumi, RIR and Sonali genotypes of chicken.

In order to identify the phenotypic and reproductive variance among some commercial layer, it was important to identify these aspects before doing this study on the commercial layer breed. Therefore, the study was designed to investigate the morphological features, productive and reproductive performances of commercial layer chicken of Fatikchari, Bangladesh. For these reason the study was done with following objectives:

1. To evaluate phenotypic criteria of commercial layer chicken.

2. To evaluate productive and reproductive performance of layer.

Chapter 2
MATERIALS AND METHODS

Study area and population:

The study was carried out through the period from 16th April to 25th May 2023 during a 1 month 10 days internship placement at Upazilla Veterinary Hospital, Fatikchari, Chattogram. The data was collected from the layer farms at Fatikchari under Chattogram district. The survey was completed with a questionnaire based on individual level data through face to face interviews and by observation of the chicken and egg characteristics. A random selected of 125 layer chickens from 5 commercial layer farms.Then recorded data were included in the study for data collection during the study period.The present study was conducted on layer

breed Rod Island Red (RIR), Fayoumi and Sonali. Total 125 birds data collected individually whereas population was formed by 5946 birds.

Geographical location of Fatikchari, Chattogram

Data collection process:

With the help of a questionnaire and interview with the owner, data were gathered on the study's goals. Information was gathered from farms based on various phenotypic and reproductive characteristics like:

1. Body mass

2. Egg count

3. Egg weight

4. Index of egg shapes

5. Shank length

6. Comb size, shape, and color,

7. Shape and size of the wattle

8. Shell weight

 9. The volume of food consumed.

Shank length and shank color :

Shank length (cm) was taken between the foot pad and the hock joint.

Shank length was measured by a simple measuring scale once with the body weight measurement for 125 layer chickens. Accounting to different varities breed, color of shank also differ from each others. In case of 'Fayoum', it was blackish, 'RIR' it was light yellowish or whitish and ' Sonali' it was light yellow.

Beak length and color

Beak length (cm) was also measured by the same simple role scale once with the body weight measurement and shank length measurement for 125 layer chickens.
For 'RIR', beak color was light brown, for 'fayoumi' it was black whitish and also for 'Sonali' it was light brown color.

Collection of eggs:

A total of 50 fresh eggs were collected from two exotic bred (RIR & Fayoumi) and a cross-bred (Sonali). Five layer chickens were chosen from each farm along with their eggs, and the eggs length, width and weight were all measured.

Egg shape Index

Length (L) and width (W) of eggs were measured with a role scale in mm.The unit mass of each egg was weighed with an balance to the nearest 0.001g. Each egg was weighed with an electronic balance to the nearest 0.001 g. Shape index (SI) was determined using the following equation (Anderson *et al.*, 2004)

ESI= (W/ L)×100

External egg quality traits:

For this study, six external egg quality traits were taken from egg.This are gross egg weight(EW) in gm, egg length(L) in cm, egg width(W) in cm, egg volume (EV) in cm^3, Shell weight (SW) in gm and egg shape index(ESI) in %.

The egg was numbered at first and then weighed on an electronic balance to measure the weights. Subsequently L and W of the eggs were determined using the formula,

$$EV = \pi \times L \times \frac{W^2}{6} \quad (cm^3)$$

Each egg was broken on a table and its contents poured into a plate. Then weighed shell weight in gm. On the basis of the measurements, the remaining egg quality trait was obtained using the following formulae (Olawumi and Ogunlade 2008):

Egg shape index, ESI (%) =W/L × 100

Moreover, the phenotypic associations between the relav external egg quality traits were measured by Karl Pearsons product moment co-efficient of correlation (r).

Feeding of layer:

The experimental farm supplied feed to Day old chick (DOC) on especial flat feeder for 2 days. Mainly for layer in average 130 gm feed was provided for each hen in every farm.

Feed ingredients were Maize, Rice-Polish, Soybean meal, Salt, Protein concentrate, Ca-P solution, Limestone, Vit premix, DCP plus, Soybean oil, Methionin, L.Lysine, Choline chloride, Enzyme, Biogest, Biostrong, NT salmonila.

Data analysis:

Microsoft Excel was used to sort and import all of the data. Using an excel sheet, descriptive data were largely used to show the outcomes in accordance with the study's objectives. Using Microsoft Excel, the mean and standard deviation (SD) were calculated. Using Microsoft Excel, the coefficient of correlation values (r) was calculated.

These statistical approaches were applied to data on different egg quality to determine the importance of any differences or correlations between the genetic subgroups of exotic and cross-bred layer chickens. A frequency study was conducted after compiling their phenotypic criteria in an excel spreadsheet along with the number of birds.
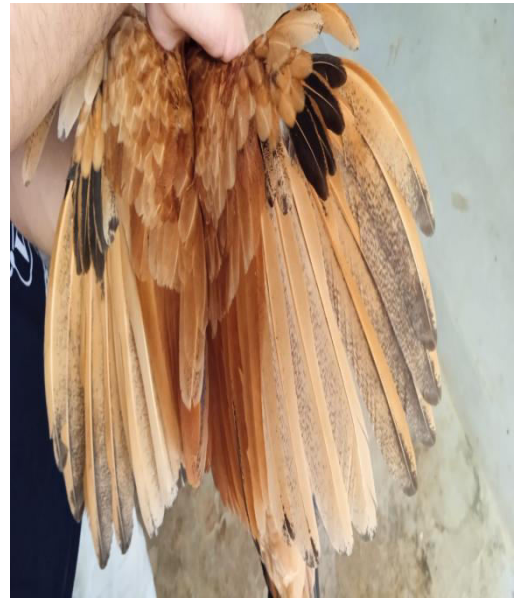
Pictures of Plumage color, Shank and comb of RIR

Pictures of Plumage color, Shank and comb of Fayoumi

Chapter 3
Result & Discussion

The study was conducted in commercial layer farm at 5 uninos, Fatikchari upazilla under Chattogram district in Bangladesh.The parameters which are related to the study with phenotypic and reproductive criteria of commercial layer breed.

Table-1 presented that the average live weight of Fayoumi, RIR and Sonali chickens were 1190±21.505 gm, 1200±79.056 gm and 1156±70.219 gm. The average egg weight(gm) of Fayoumi, RIR and Sonali chickens were 45.2±0.836 gm, 56±2.645 gm and 48±1.581 gm. That means, RIR was showed highest egg weight. Again mean egg length of Fayoumi, RIR and Sonali chickens were 4.0±1.00 cm, 6.04±0.181 cm and 5.28±0.258 cm. That means,RIR was showed highest egg length among three breed.

Table 1: Descriptive statistics of different phenotypic variables and egg quality traits in different genetic groups of layer birds.

	Traits	Fayoumi	RIR	Sonali
	Live.wt(gm)	1190±21.505	1200±79.056	1156±70.219
	Egg wt (gm)	45.2±0.836	56±2.645	48±1.581
	Egg.L (cm)	4.0±1.00	6.04±0.181	5.28±0.258
	Egg.Vol (cm^3)	33.34±1.665	63.06±6.104	44.82±5.044
	E.S.I(%)	80.88±2.565	73.83±0.560	76.19±1.860
Phenotypic Factor	Shell wt (gm)	6.5±0.598	10.62±0544	8.14±0.288
	Shank L (cm)	4.06±0.114	9.1±0.158	3.94±0.114
	Beak L (cm)	2.01±0.013	2.0±0.071	1.99±0.023
	Comb L (cm)	1.82±0.238	2.52±0228	2.26±0.260
	Comb H (cm)	1.04±0.114	1.24±0.114	1.16±0.151
	Neck L (cm)	13.34±0.882	14.38±0.593	13.38±1.103
	Wattle L (cm)	1.36±0.207	1.48±0.148	1.28±0.130
	Wattle .w(cm)	1.18±0.130	1.3±0.707	1.18±0.044

ESI=Egg shape index, Vol=Volume, L=Length, H=Height, W=Width

The average egg volume of Fayoumi, RIR and Sonali chickens were 33.34±1.665 cm^3, 63.06±6.104 cm^3, 44.82±5.044 cm^3. Egg volume of RIR was higher than Sonali and Fayoumi.

The egg weight varied from breed to breed. These results are in agreement with peebles *et al.*(2004), Silversides and Scott(2001), Oloyo(2003), Van den Brand *et al.*(2004),Rizzi and Chiericato (2005),Baumgartner *et al.*(2007),Johnston and Gous (2007).

The average Shell weight of Fayoumi, RIR and Sonali chickens were 6.5±0.598 gm, 10.62±0544 gm and 8.14±0.288 gm. In contrast to these findings, however, weights of eggs 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 of Table (Table 1) on egg weight do not support 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 though, the birds age was not same and breeds variation was present there so weights of eggs and egg shell of the study chickens had little difference. It was dissimilar with their research.

Shank length of Fayoumi, RIR and Sonali chickens were 4.06±0.114 cm, 9.1±0.158 cm and 3.94±0.114 cm. Again Beak length of Fayoumi, RIR and Sonali chickens were 2.01±0.013 cm, 2.0±0.071 cm and 1.99±0.023 cm.

Among their Shank length, beak length, comb length ,comb height neck length, wattle length and width have not so much variation. Shank length of Sonali is nearly similar to Olawunmi *et al*(2008), but others are not similar.Due to breed variation, different rearing, feeding system of chickens in different farm, shank length of RIR and Fayoumi are not similar with Olawunmi *et al*(2008).

Neck length of Fayoumi, RIR and Sonali chickens were 13.34±0.882 cm, 14.38±0.593 cm and 13.38±1.103 cm. The result of three breeds nearly similar.

In this study, the mean egg shape index (SI) values were 73.83±0.560% for RIR, 76.19± 1.860% for Sonali and 80.88±2.565% for Fayoumi eggs. There was not so much difference among the value.

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Table 2: Frequency of different phenotypic criteria.

Traits	Color	Fayoumi		RIR		Sonali	
		No.	Freq. (%)	No.	Freq. (%)	No.	Freq. (%)
Plumage color	Black and white	21	84	0	0	0	0
	Red brown	0	0	22	88	2	8
	Golden brown	0	0	3	12	23	92
Shank color	Blackish	25	100	0	0	0	0
	Yellowish	0	0	25	100	25	100
Beak color	Blackish	20	80	1	4	0	0
	Yellowish	5	20	24	96	25	100
Egg color	White Brown/Brown	0	0	25	100	25	100
	White	25	100	0	0	0	0

No difference in color and type of comb among three breed was found. The color and type of comb was found Reddish and single which is agreed by other researchers (Anonymous, 2015; Halima *et al*,2007a)

Plumage color of Fayoumi was 84% Black and White while RIR was 88% Red brown and Sonali was found 92% Golden brown color. Due to breed variation their plumage color was different with the breed.

The Shank color of Fayoumi was 100% blackish and for both RIR and Sonali hen was found 100% yellowish which was similar any type that is agreed by other investigators (Guni and Katule, 2013; Anonymous, 2015). No difference in Egg color between RIR and Sonali bird was found. It was 100% Brown color whereas Fayoumi egg was 100% white.Though they had diiferent genetic criteria so egg shell color was different.

100% yellowish beak was found in Sonali whereas Fayoumi and RIR have some color variation with blackish 80% and yellowish 96%.

No difference was found in egg shell color of RIR and Sonali layers, the egg shell was brown in color, which is agreed by Hendrix Genetic Company limited (Anonymous, 2015).

Table 3: Production performance of different genetic group of exotic and cross breed birds.

Breed name	Fayoumi	RIR	Sonali
Per month of egg production	20±1.581	19.2±1.303	19±1

From the statistical data, it is realized that according to the number of bird ,Fayoumi produce little more eggs per month than RIR and Sonali. Ii was 20±1.581whereas RIR and Sonali egg production were 19.2±1.303 and 19±1. Though different factor were responsible for producing more eggs. It is vary according to breed, farms condition, feed ingredients.

Production number is more in Fayoumi but egg quality traits are higher in RIR and Sonali than Fayoumi chicken.

Table 4: The phenotypic correlations between external quality traits of eggs from three genetic groups of commercial layer in Fatikchari Chattogram.

Breed name	EW EV	EW SW	EW ESI	EL ESI	Ewi ESI
Fayoumi	-0.653ns	-0.549ns	0.105ns	0.691*	0.723*
RIR	0.824**	0.867**	0.322ns	0.424ns	0.596ns
Sonali	0.834**	0.714*	-0.877ns	-0.809ns	0.479ns

EW=Egg weight, EV=Egg volume, SW=Shell weight, ESI=Egg Shape Index, EL=Egg Length , Ewi=Egg width , ns=Non significant, *= $P<0.05$; **=$P<0.01$;***=$P<0.001$

As presented in Table 4, all chicken breeds showed insignificant correlations for external egg quality traits between EW and ESI; EW and EV excepting RIR and Sonali (r = 0.824, 0.834;P<0.01); EW and SW excepting RIR and Sonali (r =0.867 , P<0.01; 0.714, P<0.05);again for EL vs ESI and Ewi vs ESI the correlation showed insignificant for RIR and Sonali. However, significant correlations were found to exist between EW and EV for RIR and Sonali chicken under study. Again correlation between EW vs SW of RIR was significant and that was r=0.867, P<0.01.The phenotypic associations between external egg quality traits in the chicken breeds revealed interesting findings.

As regards the significant correlations between various external egg quality traits, the present findings on exotic and crossbred agree with Isa Brown layers (Adedeji *et al*. 2008; Olawumi and Ogunlade 2008). Moreover, the negative correlation values between EW and ESI of the present study agree with Pohle and Cheng (2009) and Momoh *et al*. (2010).

Since hen's eggs make up a significant portion of the human diet, their nutritional profile, in particular its antioxidant and fat contents, are significant because yolk mass is correlated with cholesterol levels (Abdullahi *et al*. 2003; Sparks 2006).

In comparison to Fayoumi and Sonali eggs, RIR and Indigenous eggs have significantly higher egg weights due to more albumin and yolk values. Because the former genotype has higher yolk ratio values, it can be suggested that they are better layer varieties of chicken that are suitable for raising and marketing in Fatikchari. However, through breed evaluation and breeding, together with efficient feeding, management, and disease control programs at the farm level, should be prioritized for strengthening these layers.

Chapter 4
CONCLUSION

In Bangladesh, the population of commercial layer strain is growing. The only animal that is supposed to be present in a settlement and provides both food and revenue is chicken.

Therefore, focus should be placed on maintaining the chicken population by stakeholders (policy makers, research and development groups). The presence of a commercial layer strain with a diverse phenotypic appearance may be due to Bangladesh's diverse agro ecologies. The majority of communities across the nation have been relating these morphological traits of commercial layer chicken to their social beliefs and way of life. This could have an impact on poultry market values. Therefore, the production goals and trait performances of the society should be incorporated into every breeding and improved production program of the commercial layer.

It has always been possible to get higher performance out of commercial layer birds by refining the methodologies and conventional management methods.Therefore, it is important to prevent genetic degradation and use scientific selection and genomics technology to improve this vast gene pool.

External egg quality traits of Fayoumi, RIR ,Sonali chicken breeds available in Fatikchari were studied. There was 88% Red brown RIR, 84% Fayoumi and 92% Sonali chicken. Their shank color had found variation like Fayoumi had 100% Black shank, RIR and Sonali both had 100% yellowish shank RIR produced 56±2.645 gm egg whereas Fayoumi and Sonali produced 45.2±0.836 gm and 48±1.581gm. That means RIR produced heavier eggs than Fayoumi and Sonali chickens. Moreover, Fayoumi produced 100% white while RIR and Sonali egg color was 100% brown. From this study it may be concluded that three genetic groups of chicken had physical variation for both qualitative and quantitative traits and had little significant correlation with external egg quality variables among the breed.

Chapter 5
Limitation

 The study was conducted to a specific region which was a rural area.So it was to find out the specific area. Due to one-month duration of the study might need to account for seasonal variations that could impact chicken growth, egg production, and other factors. Reliance on farmer self-reported data could result in biases and inaccuracies from reporting and recollection mistakes.

Chapter 6
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Biography

This is Rumi Akter, the second child of Md. Enamul Haque and Farida yasmin, doing her graduation in Doctor of Veterinary Medicine (DVM) at Chattogram Veterinary and Animal Sciences University under the Faculty of Veterinary Medicine. She passed the Secondary School Certificate Examination (SSC) in 2017 from Saraipara city corporation high school and the Higher Secondary Certificate Examination (HSC) in 2017 from Govt. Chattogram college, Chattogram. Currently, she is doing her yearlong internship. She has a great interest in pet practice and want to be a veterinary surgeon or any Government senior officer in future.

Appendix
Questionnaire

Demographic Data of Farmer:

1. Owner name
2. Age
3. Gender
4. Educational qualification
5. Family size
6. Farming system

Phenotypic Characteristics:

Question	Response
Age and number of the chicken	Month and number
Body weight	In gm
Plumage color	Brown/ Black and white
Shank color	Yellowish/ Black
Shank length	In cm
Comb type and color	Red
Wattle color	Red/White
Egg weight	In gm
Egg color	Brown/White
Beak color	Yellowish/Blackish