Evaluation OF EGG PRODUCTION AND EGG WEIGHT OF ISA BROWN AND BOVANS BROWN STRAINS AND PREDICT THE VALUES BY FITTING THE REGRESSION MODELS

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EVALUATION OF EGG PRODUCTION AND EGG WEIGHT OF ISA BROWN AND BOVANS BROWN STRAINS AND PREDICT THE VALUES BY FITTING THE REGRESSION MODELS

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ABSTRACT

Egg production and egg weight are the most important traits for the layers. Mathematical models are used to predict values from incomplete or partially recorded data and reduce confusion in calculating the yield. Therefore, a study was conducted to know the production performance of both Bovans Brown and Isa Brown strains and predicted their yield using regression models. The present study was conducted to know the egg production and egg weight of Bovans brown and Isa Brown layer strains on six farms in the Chattogram area. The average egg production and egg weight of Bovans brown were obtained at 307.971± 7.378 egg/hen/year and 63.973±0.961 g/egg and for ISA brown the average egg production and egg weight were obtained at 303.403±2.936 egg/hen/year and 63.361±0.8739 g/egg, respectively. The R^2 value was used to compare the model performance. The predicted value of the average egg weight of both strains was higher than the actual value. But the predicted value of the average egg production per hen/year was similar to the actual value in both strains.

Keywords: Production performance, Strains, Fit statistics, Predicted value.

1. Introduction

Poultry as an aspect of livestock production is important to the biological needs, economic and social development of the people in any nation (Oladeebo and Ambe-Lamidi, 2007). There is a great market for commercial poultry farming in Bangladesh. The economic system of Bangladesh is mostly dependent on agriculture and agricultural-related production. Poultry products like meat and eggs are the main animal protein source for the people of Bangladesh. Nowadays, there are numerous highly productive poultry breeds are available and suitable for commercial production.

Egg production is an important part of the commercial poultry industry. Commercial layer strains Such as (ISA Brown, Shavar-579 Brown, Hy-line Brown, Bovans Brown, Hy-sex Brown, Novogen-Brown, Hy-sex White, Hy-line, and Hy-line White) produce eggs for food and egg processing industries. Egg consumption on regular basis can effectively correct nutritional imbalance among vulnerable group particularly nursing mothers and children (Olawumi et al; 2006). Egg production in poultry is a complex quantitative trait and shows considerable individual variation over the laying period. Number of eggs produced per unit of time is the basis for assessing egg production efficiency (Ganesan et al., 2011)

Layer strains are produced by breeding companies on the basis of selection of different desirable traits-age of sexual maturity, egg production per hen, age of peak egg production, livability etc. Among different desirable traits egg production per hen is the top most important trait for the selection of layer strains for commercial layer farms (Bennewitz et al., 2007). More than 10 commercial layer strains are available at the field level in Bangladesh (Hasan et al., 2021). Due to genetic variation egg production and quality differ among strains.

The rate of egg production is the most important trait in layers because it determines the number of egg production in a definite period. No other trait has the importance of egg production rate as a single indicator of egg layer efficiency. The age of birds remains one of the important factors required for improved quantity of eggs (Nwogu and Acha, 2014)

Egg laying in poultry begins at sexual maturity and quickly reaches peak production and declines with hen age. ISA brown and Bovans brown are also good egg-producing poultry strains. Eggs hen housed of ISA Brown strain is 470 between (18 to 100 weeks) (ISA-

poultry.com). And eggs hen housed of Bovans Brown strain is 473 between (18-100 weeks) (Bovans.com)

For many years, egg production studies have been applied for modeling. Simulation modeling can assist in better understanding of a farming system by estimating the productivity from partially complete and missing data. Modelling integrates knowledge of the components of a farm system with their interactions and can be used to identify differences in efficiency of production by varying inputs & outputs (Olney & kirk, 1989). Various types of models for the egg production of poultry have been found in literature: a simple 3 parametric model (wood model) for individual weekly egg production logistic model, which including the both increasing and decreasing phase (Yang at el.,1989; Grossman and Koops, 2001; Khan & Ahmed, 2010) and a stochastic simulation model of egg production (Alvarez and Hocking, 2007). Accurate modeling of commercial layers at different ages of egg production may facilitate better understanding of egg production dynamics which could eventually lead to a great improvement in poultry farm profits (Ahmad, 2011). By using mathematical models, it is easy to estimate the productivity on a farm. Using models, one can predict values from incomplete or partially recorded data. Prediction of total egg production as early as possible during the laying cycle using part records facilitates a poultry breeder to select breeding birds early therapy helping in reducing the cost of egg production (Ganesan et al., 2011). The most common models of regression analysis are simple linear and multiple linear where the dependent and independent variables show a linear relationship. But the applicability of models on egg production in a tropical environment like Bangladesh is limited.

The current study was designed with the objectives

I. To assess the productive performance (egg production and egg weight) of Bovans brown and ISA Brown.
II. To fit the regression models for prediction of the egg production and egg weight of these strains.

2. Materials and Methods

This study was conducted from January to May 2022 on layers of both Bovans and ISA brown (no. layers 17000) strain from 6 farms at Patiya Upazila, Chattogram. Birds were reared in an open-sided shed in a cage system. The data was collected from farm owners and staff on weekly basis.

2.1. Data entry: The raw data were collected and entered in a spreadsheet by following the name of the strain, the number of birds, average egg production, and average egg weight. The data were collected from those farms from the strain, Isa brown and Bovans brown layer of 30 to 37 weeks, 47 to 56 weeks, and 80 to 88 weeks age to compare between the strains at the same laying stages. The average egg production and egg weight of both strains were calculated from the weekly collected data.

2.2. Modeling the performances: The linear and polynomial were used to predict the egg production and egg weight of Bovans brown and Isa brown strains. The regression equation was as:

Linear, $Y = a + bx + e$ ------- (1)

Polynomial, $Y = a + bx + cx^2 + e$ -------- (2)

Where Y is the value of traits, x is the ages of hens, and a, b and c are parameters that define the shape of the curve, and e is the random error distributed as normally $(N (0, \sigma^2)$.

2.3. Statistical analysis:

The linear and polynomial regression was fitted using data of age and egg production of both strains and plotted in Microsoft excel (2016) for getting predicted values of egg weight and egg production. To compare the linear models using the goodness of fit statistics R^2 (coefficient of determination) with actual and predicted egg production & egg weight. The mean with standard error values of the studied traits was estimated following a completely randomized design ($Y = \mu + T_i + e_{ij}$, where Y is the parameter value, T_i is the i^{th} treatment and e_{ij} is the random error, N (0, σ^2) using Proc GLM of SAS (SAS, 2010). The mean differences were compared using SEM value.

The SEM computed was calculated as:

$$SEM = \frac{SD}{\sqrt{n}}$$

Here,

SEM=Standard Error of Mean; SD=Standard Deviation; n = Sample size.

3. Results and Discussions

3.1. Productive performance of Bovans brown and Isa brown

The egg production and egg weight of Bovans brown and Isa brown are shown in table 1. Table 1, indicates that the average egg production and egg weight of Bovans brown was higher than the ISA brown strain. In Bovans brown, the average egg production was (307.971±7.378 no/hen/year) and egg weight was 63.973±0.961g), which was higher than ISA brown's egg production and egg weight.

3.2. Model parameters of different traits and curve shape

The values of the components of the liner and polynomial regression equation of egg production and egg weight are shown in Table 2. (a) (b), respectively. Figures 1 to 6 showed the curve shape of the weekly egg production and egg weight after fitting the linear and polynomial regression parameters. The shape of the regression curve differed between linear and polynomial regression within the same trait.

Table 1*: Productive performance of Bovans brown and Isa brown strain*

Phase	Bovans brown	Age (week)	Egg production(no/hen/year	Egg weight(g)
1		30-37	341.78^{c} ± 7.747	60.13756^{c} ±0.83
2		47-56	314.61^{b}±7.335	63.70^{b}±1.190
3		80-88	267.52^{a}± 7.0546	68.083^{a}±0.8569
		Average	307.97^{b}±7.378	63.973^{b}±0.961
		SEM	15.34	1.62
	ISA brown			
1		30-37	336.539^{c}±3.509	62.00^{C}±1.008
2		47-56	296.653^{b}±2.933	63.195^{b}±0.6869
3		80-88	277.018^{a}±2.368	64.888^{a}±0.927
		Average	303.403^{b}±2.936	$63.361^{\mathbf{b}}$±0.8739
		SEM	12.38	0.59

The mean differences between the two mean was tested using SEM value. In table 1. we observe from the SEM value that in phase 2 (47 to 56) weeks of age the egg production and egg weight of both strains are more precise than other 2 phases (30 to 37 and 80 to 88) weeks of age.

Table 2: *Estimated model parameters (a, b) fit statistics (R^2), and predicted value of egg production of Bovans brown and Isa brown*

		Linear regression				Polynomial regression			
	Age (weeks)	a	b	R^2	Predicted value (Egg/hen/year)	a	b	c	R^2
Bovans brown	30-37	0.9135	0.0051	0.344	335.07	0.8644	0.0345	-0.0033	0.9147
	47-56	0.8327	0.0053	0.6401	305.578	0.8138	0.0148	-0.0009	0.7478
	80-88	0.7417	-0.0017	0.061	270.264	0.7648	-0.0144	0.0013	0.2257
				Average	303.63				
Isa brown	30-37	0.9302	-0.0018	0.2125	338.90	0.9195	0.0046	-0.0007	0.3441
	47-56	0.8263	-0.0025	0.8566	300.833	0.8238	-0.0012	-0.0001	0.8678
	80-88	0.7676	-0.0017	0.5372	279.699	0.7638	0.0004	-0.0002	0.5774
				Average	306.4				

Table 3: Estimated model parameters (a, b and c), fit statistic (R^2) and predicted values of Egg weight of Bovans brown & ISA brown

		Linear regression				Polynomial regression				
	Age (wks.)	a	b	R^2		Predicted value (Egg wt. g)	a	b	c	R^2
Bovans	30-37	61.116	0.1964	0.2274		72.927	58.462	0.4363	-0.0113	0.9599
	47-56	61.727	0.3588	0.8323		84.58	62.027	0.2088	0.0136	0.84
	80-88	67.583	0.1	0.1021		74.39	66.363	0.7656	-0.0666	0.3344
					Average	77.29				
ISA	30-37	58.632	0.3345	0.9555		79.371	58.884	1.5357	-0.1488	0.7496
	47-56	64.03	-0.1518	0.4477		54.43	64.567	-0.4206	0.0244	0.5219
	80-88	63.597	0.2583	0.5813		80.355	62.298	0.9672	-0.0709	0.8059
					Average	71.385				

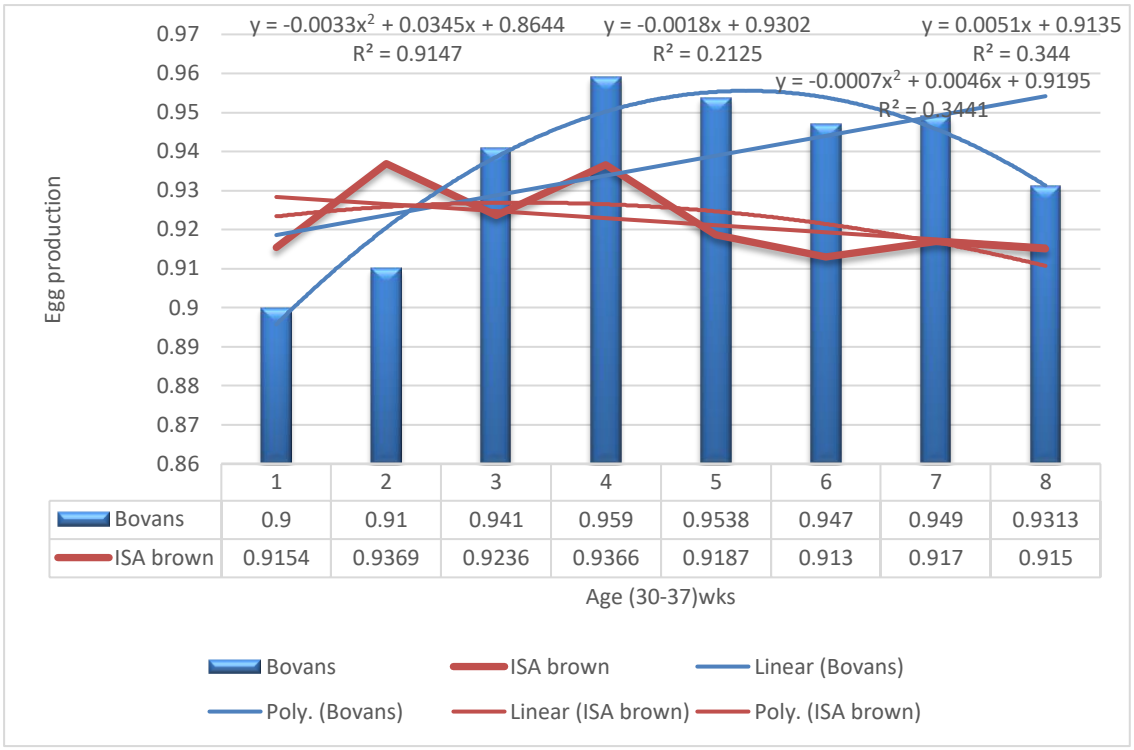

***Figure 1**: Egg production curve (30-37 weeks)*

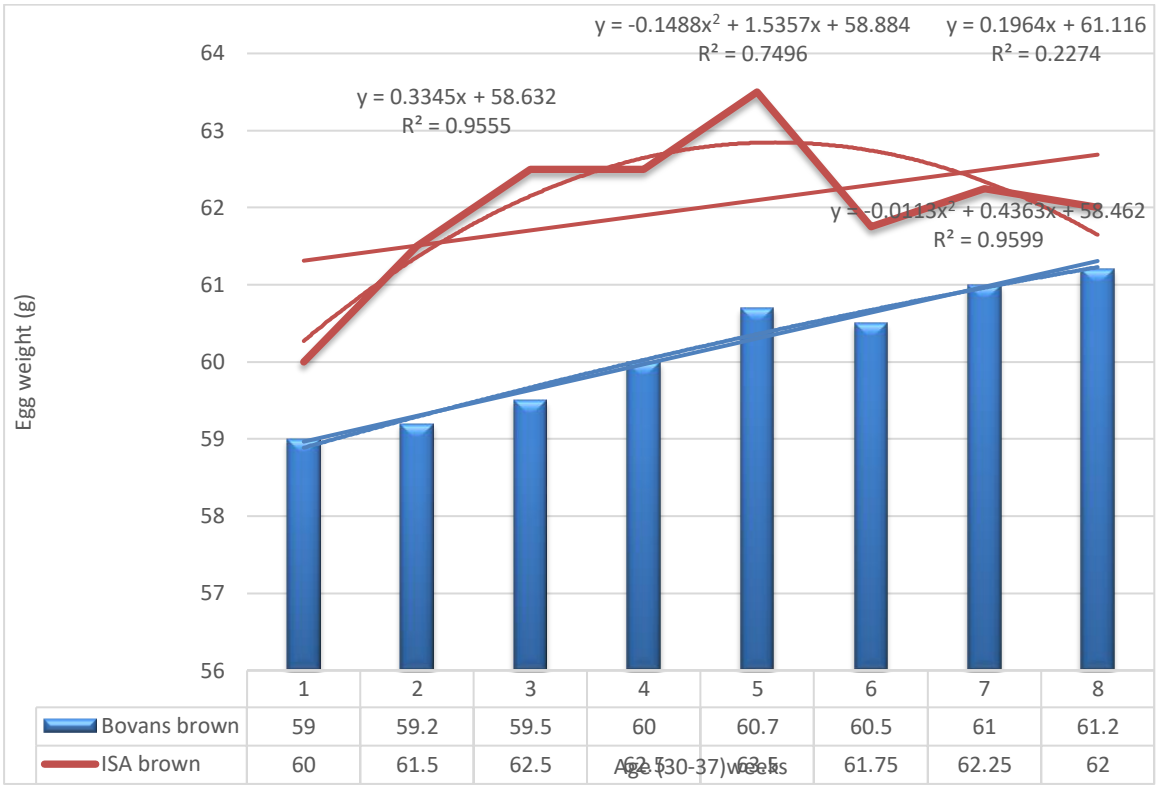

***Figure 2:** Egg weight curve (30-37 weeks)*

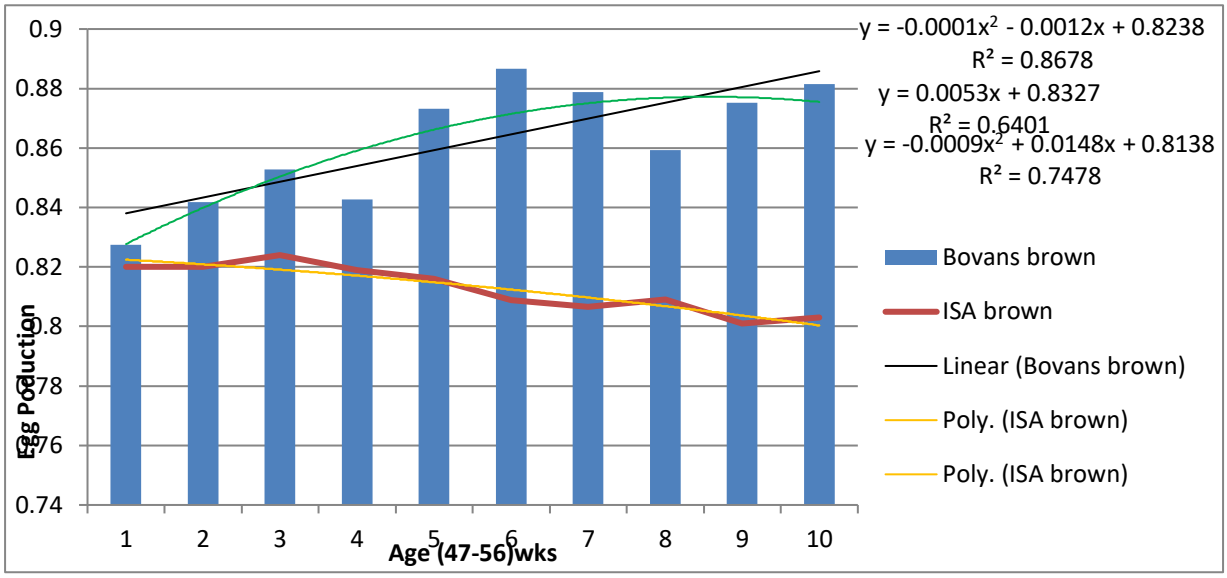

***Figure 3**: Egg production curve (47-56 weeks)*

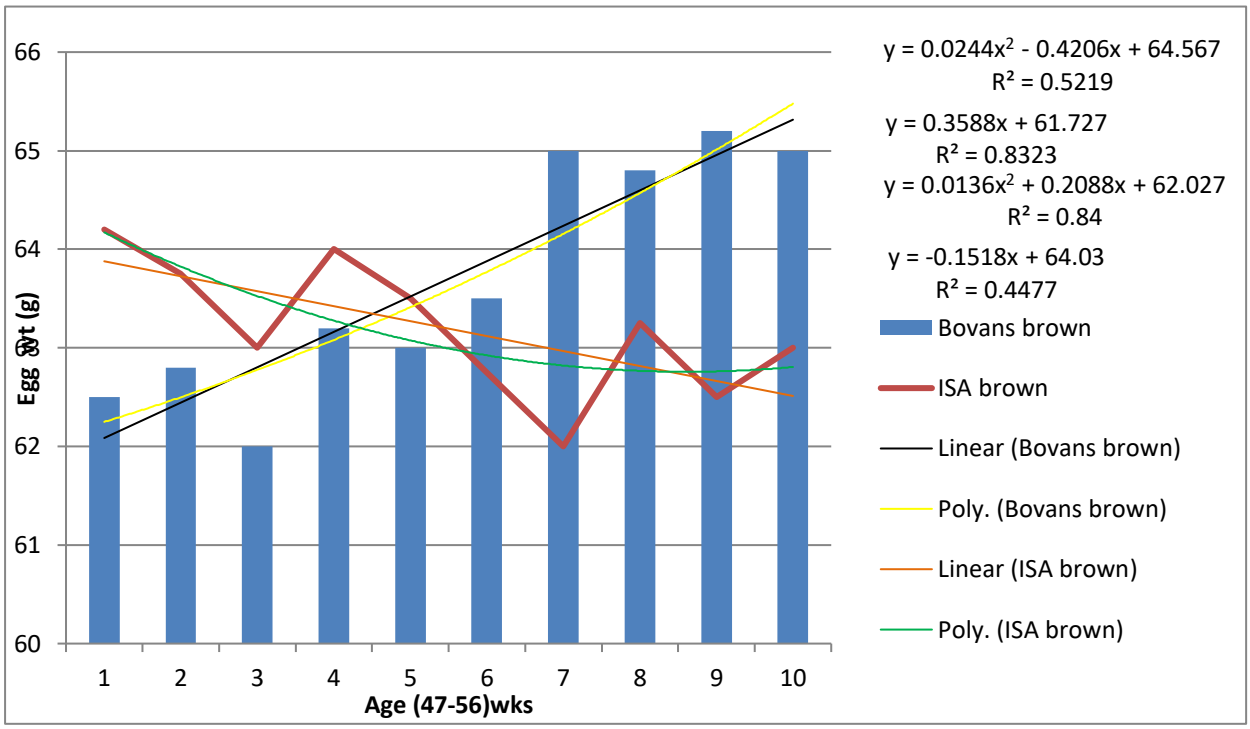

***Figure 4**: Egg weight curve (47-56 weeks)*

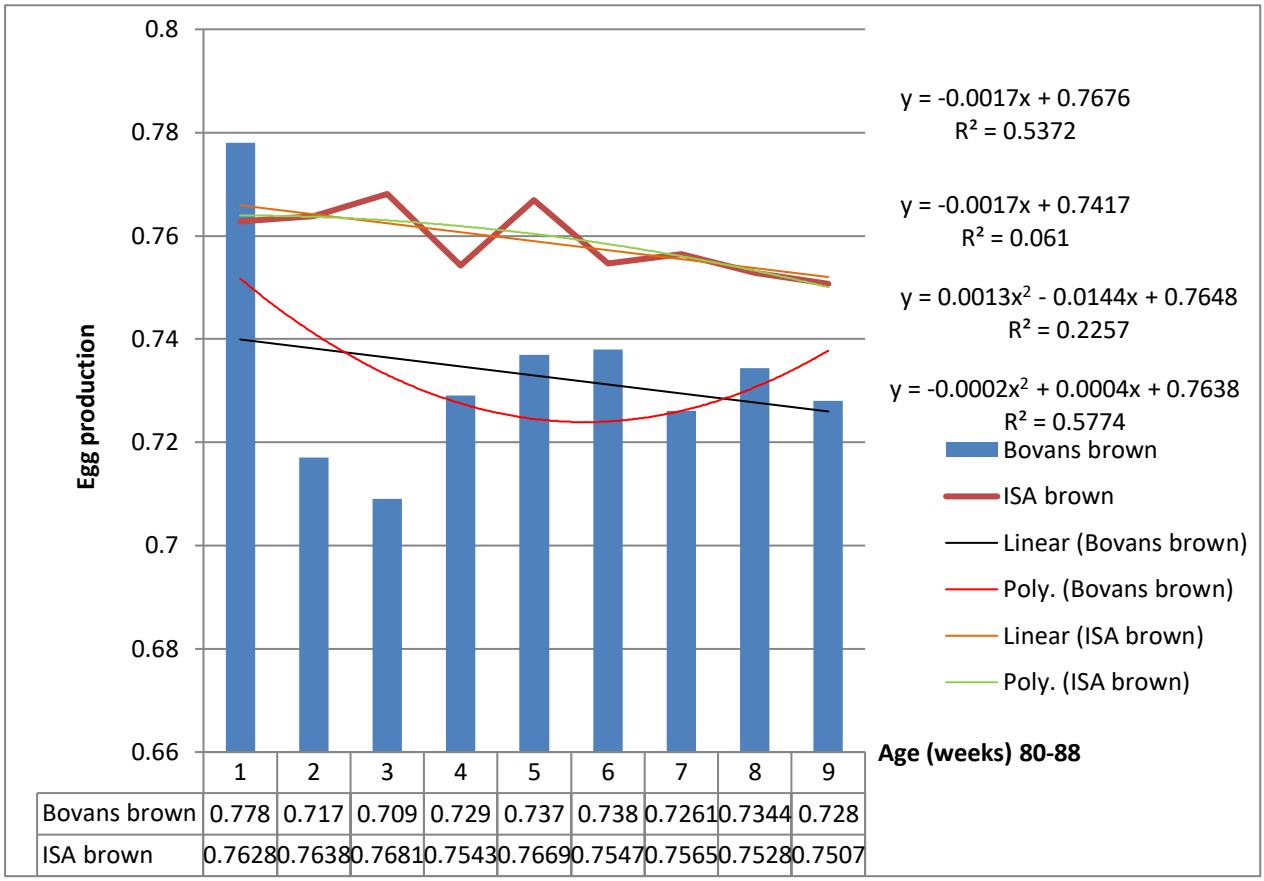

Figure 5: *Egg production curve (80-88 weeks)*

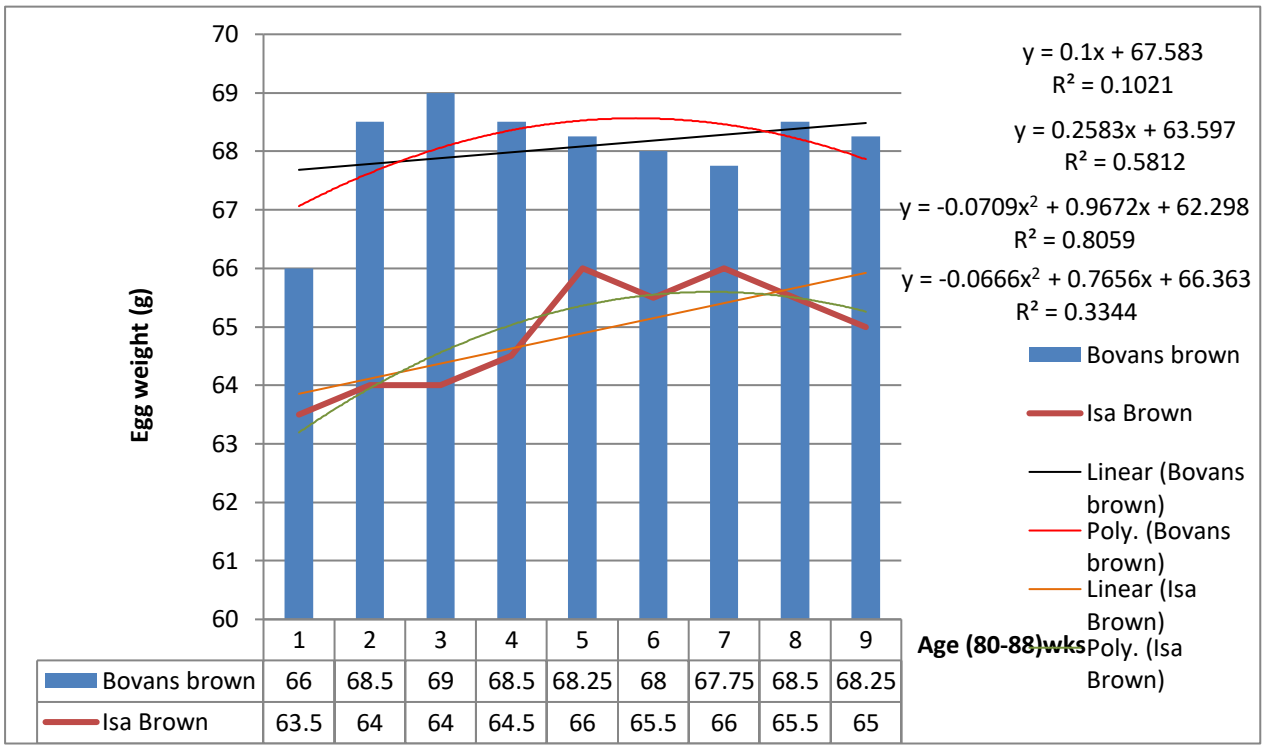

Figure 6: *Egg weight curve (80-88 weeks)*

3.3. The goodness of fit

Here, in polynomial regression (Table 2) the highest R^2 value of egg production was found in Bovans brown strain at 30 to 37 weeks of age and low at 80 to 88 weeks of age. In a linear regression model, the highest R^2 value was found in the Isa brown strain at 47 to 56 weeks of age and low in the Bovans brown strain at 80 to 88 weeks of the same age. However, the highest R^2 value of egg weight in polynomial regression (Table 3) was found in the Bovans brown strain at 30 to 37 weeks of age and low at 80 to 88 weeks of age in the same strain. In linear regression, the highest R^2 value of egg weight was found in Isa brown strain at 30 to 37 weeks of age and low in the Bovans brown strain at 80 to 88 weeks of age.

The lower R^2 value of egg production and egg weight indicated the difference between models and also between actual and predicted values. The higher R^2 value indicated a good fit between models and between actual and predicted values (Alam et al., 2009 and Khan et al. 2012; Ghosh and Khan, 2014). The predicted yield also differed with the predicted ability of the model parameters, model functions. Similar factors were also reported by Vargas et al. (2000); Brown et al. (2001); Alam et al. (2009); Khan et al. (2012) and Sultana et al. (2022). The lower or medium R^2 value of this study of different laying phases is due to less adjustment with the length of production. The length of egg production has the positive effects on total egg production agreed well with Johnston and Gous, (2006).

3.4. Actual and predicted value of egg production and egg weight

In this study, the actual value of average egg production of Bovans brown was 307/hen/year; whereas the predicted value was 303.63/hen/year. And the actual value of average egg production of Isa brown was 303.4/hen/year and the predicted value was 306.4/hen/year. The predicted egg production of both strains was close to the actual value in the linear regression model. For egg weight, the actual value of the average egg weight in the Bovans brown strain was 63.97g/egg and the predicted value was 77.29 g/egg. On the other hand, the actual value of average egg weight of Isa brown strain was 63.36g/egg and the predicted value was 71.38 g/egg. It was seen that the predicted value of the average egg weight of both strains was higher than the actual value.

Limitation

The data of the whole production cycles of both strains were not included here due to the short period. Management issues are also excluded here. These are the lacking of this study.

Conclusion

Both the Bovans brown and Isa brown layer strains are appearing to be good performers under Bangladeshi conditions. The actual egg production and egg weight of those strains are at standard level and the difference in performance is negligible. The predicted value of egg production of both strains is close to the actual except egg weights. Here, the predicted value of egg weight was higher than the actual value. Further study such as more order polynomials and other non-linear and logistic models to get more accuracy in prediction is recommended. This study may help the researchers and other personnel related to commercial layer farming in decision-making and rearing those commercial layer strains.

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Biography

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