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Research Article

Comparison of production characteristics of BLRI-developed layer strain-2 (Shorna) with commercial ISA Brown

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Abstract

The existing research program was undertaken to associate the presentation of Bangladesh Livestock Research Institute (BLRI) settled layer strain-2 "Shorna" with a commercial strain (ISA Brown). To conduct this study, a total of 120 ISA Brown and 120 Shorna pullets were selected at chance from the prevailing batch at the age of twelve weeks. Birds were arranged in a completely randomized design, with six replications having 20 birds in each replication. Non-significant results were found in the case of feather sexing accuracy between two brown egg-laying strains. The egg weight and the egg mass production were found to be significantly ($p < 0.05$) higher in Shorna than in ISA Brown, whereas the egg production rate fell for Shorna compared to ISA Brown. In terms of body weight or feed consumption, there was no statistically significant difference between Shorna and ISA brown, and neither of the studied layer chickens had an impact on their FCR. Higher serum phosphorus and antibody titer levels were found in Shorna than in ISA brown ($P<0.05$). Additionally, the Shorna strain had more ovarian follicles than the ISA brown strain ($P<0.05$). Therefore, it may be assumed that these results prove Shorna is equivalent to an ISA brown laying chicken.

Introduction

Poultry is one of the most potentially rising sectors in Bangladesh, which has witnessed around a 20% growth rate in recent years (Khan et al., 2021). To eradicate poverty and make Bangladesh a healthy nation by supplying animal protein to its people, the government has also emphasized this sector by setting specific goals. According to a report (BPICC, 2018), the country would need to produce around 1480 crores of eggs and 12.5 lac MT of chicken meat during 2021 to meet the per capita poultry egg and meat consumption set by the Food and Agriculture Organization of the United Nations (FAO, 2015). Although the per capita meat consumption target has just been fulfilled (DLS, 2017), egg intake has yet to be fulfilled, which is fixed at 104 eggs per person per year by FAO. To address the deficiency, the country has to depend on the import of Grand Parent (GP) or Parent Stock (PS) chicken by a few breeding companies considered one of the main causes of the Day Old Chick (DOC) price hike. Although there are government-run poultry farms and hatcheries throughout the country, they can supply below 1% of the total DOC demands (Gayen and Rehana, 2012). Therefore, it's crying out to develop high-yielding poultry strains locally to ensure fair prices of DOC and target-based egg and meat production, as well as save a huge number of foreign exchanges spent on the import of GP or PS (Farrelly, 2012). Besides, Bangladeshi poultry breeding companies import GP and/or PS mostly from temperate countries, which are not always adaptable in frequently changing tropical environments like Bangladesh. Thus, poultry farmers and entrepreneurs are under threat and must always pay special attention to the management, rearing, and maintenance of biosecurity of imported chicks under the existing environmental conditions of Bangladesh (Ali et al., 2022; Rahman et al., 2022). So, farmers must spend extra money to buy vaccines and medicines to keep their birds healthy, especially during the hot summer months when the environmental temperature goes up to 36-39^{0}C or above. In this light, the emergence of high-yielding layer strains, like those seen in imported commercial strains, has long been desired in our country. With technical assistance from the Japan International Cooperation Agency (JICA), the Bangladesh Livestock Research Institute (BLRI) has improved a white layer strain known as "BLRI Layer Strain-1 or Shuvra". Recently, BLRI has advanced another layer strain named 'BLRI Layer Strain-2 or Shorna' through the incessant range and trip between two specialized lines of the conserved purlines and tested it in on-station farming conditions for addressing a variety of emerging issues. DOC of Shorna was sexed distinctly by barb color—male chickens have whitish fluffs while the feminine has a brown color. This strain is known for its brown eggs, high feed conversion efficiency, persistent egg production, and larger egg size. Beginning at roughly nineteen weeks of age and continuing for more than eighty weeks, this strain of layer begins producing eggs that are brown in color (Hassan et al., 2015). Considering the above situation, the present research was assumed to compare the production performance, egg qualities, and blood properties between Shorna and commercial laying hens (ISA Brown).

Materials and Methods

Bird and management

To conduct this experiment, a total of 120 ISA Brown and 120 Shorn pullets were randomly selected from the existing flock of the BLRI Poultry Research Farm at 12 weeks of age. It is noted that all the birds were identical up to the inception date of the experiment. However, all 240 laying hens were randomly allocated to the treatments (6 replications per treatment; 20 birds per replication). Until the completion of the 72-week research period, birds were raised in straight, distinct layer birdcages of 864 cm^2/hen with dimensions of 24 cm width and 36 cm length. To reduce cage-level effects, the replicates were evenly distributed throughout the top and lower levels. A total of 120 g of feed per bird with ME, 2700 Kcal/ kg, CP 17 %, Ca 3.5 %, and P 0.42 % was given twice a day at 08:00 AM and 3:30 PM. Subsequently, the refusals were documented the next morning. Clean, fresh, and safe consumption of water was obtainable all the time. At twelve weeks of age, the light was provided for 12 hours, increasing by 30 minutes per week until it reached 16 hours at twenty weeks. The death was confirmed as it occurred, and eggs were produced every afternoon. The birds were raised following layer strain guidelines.

Measurement of performance

Feed Intake (FI) and Egg Production (EP) were recorded daily for each treatment, while body weight (BW) and egg weight (EW) were meticulously recorded weekly. Based on EP, EW, and FI, egg mass (EM) (% of egg production egg weight/100) and feed modifications (g of feed/g of egg mass) were calculated.

Egg quality measurement

Ten eggs (sixty eggs per treatment) were randomly chosen from each duplicate cage tier to assess the limits of egg quality. Using an eggshell strength sample (Fujihira Industry Company Limited in Japan), the eggshell breaking asset was calculated and expressed as a unit of density force applied naked to a unit of eggshell surface area (kg/cm2). Then, using an Egg Quality Measurement Stand (FHK Japan), the height and width of the albumen and the yolk of selected eggs were measured. The Minolta Chroma Meter CR-200 was used to gauge the color of the eggs. For Haugh unit calculation, the following formula was used: $HU (\%)=100 * \log (H-1.7W^{0.37}+7.6)$Where:HU = Haugh unit, H= observed height of the albumen in millimeters, W = weight of the egg in grams.

Measurement of blood properties

After the experiment ended, 10 birds from each treatment were chosen at random. Marginal blood samples were taken from the birds' arms, allowed to clot for two hours at room temperature, centrifuged at 1500 rpm for 15 minutes at 4°C, and the sera were then prepared and stored at -20°C until analysis. The manufacturer-recommended turbidimetric method was used by Humalyzer 2000 Chemistry (Germany) to detect total cholesterol (TCL), serum triglycerides (TG), high-density lipoprotein (HDL), calcium, phosphorus, and magnesium (mg/mL). In accordance with Wall et al. (2008), 10 blood samples from the wing vein per treatment were collected, smears were laid out, lymphocytes were counted at a threshold of 100 (using an oil immersion lens), and H/L was determined. Based on Sabrin et al. (2012), the antibody titers against hemagglutination inhibition (HI) in the serum samples were determined.

Ovarian morphology dimensions

At the completion of the study, 10 birds from each strain were randomly chosen and slaughtered humanely, and the weights of the ovary and stroma were recorded. Sincere care was taken during the handling process to prevent ovarian injury from pointless post-mortem procedures. The total weight of the ovary, the stroma, and the big yellow follicles (TLYFW) were all limited in terms of g. The number of follicles was counted, estimated, and organized according to size. The ovarian remnant was placed in 10 % shielded formalin after being briefly washed in saline solution (9 g NaCl/L). According to Hassan et al. (2013), the fit follicles were sized after the yolk had been hardboiled (2–3 days after fixing), and the breadth was assessed.

Statistical analysis

A one-way ANOVA was used to analyze all the data by using the Proc GLM statistical analysis system (SAS, version 9.1, Cary, NC, USA, 2005). Steel and Torrie's novel multiple-range test was used to distinguish the significant differences between treatment means. P-values under 0.05 were regarded as significant.

Results and Discussion

Laying performance

The act of laying hens through the complete trial period (twenty to seventy-two weeks) is presented in Table 1. The existing research exposed non-significant ($p > 0.05$) outcomes of DOC weight, sexing accuracy, age at sexual maturity (ASM), mature body weight, feed conversion ratio (FCR), daily feed consumption, and annual total egg production while comparing Shorna and ISA Brown chickens. Although Shorna started laying eggs about four days earlier than commercial ISA Brown. However, significant differences ($p < 0.05$) were found in egg weight, egg mass, and the typical egg production proportion of twolayer strains. This result was supported by Roll et al., (2008) and Ragheb et al., (2013), who stated that over 82% of annual egg production in Hy-line Brown and ISA Brown strains was nurtured from 19 to 78 weeks of age in furnished cages, but did not agree with Islam et al., (2013). These might be due to the use of different parent lines, housing, and management systems for birds, in addition to strain performance differences in various experimental environments. Although the egg production rate was slightly lower in Shorna, egg weight, and egg mass were significantly higher ($p<0.01$) compared to ISA Brown. The present findings agreed with previous results by Islam et al., (2015), Hendrix Genetic (2018), and Ragheb et al., (2013) who testified to more than 62g of egg weight in commercial ISA Brown or Hy-line Brown strains. The egg mass of Shorna was higher compared to ISA Brown or Hy-line Brown strains due to the heavier egg size, which might also be attributed to the superior genetic potentiality of the BLRI developed layer strain. This statement is supported by the author, Yigzaw et al. (2021), who states that egg weight is the key factor controlling egg mass production when observing three commercial layer strains in their experiment.

However, Khawaja et al. (2012) compared egg mass production for deshi with commercial strains and found lower value for deshi under an intensive production system.

Table 1. Comparative performances between Shorna and ISA Brown layer strain (20-72 weeks)

Parameter	Shorna	ISA Brown	SEM	P value
Sexing accuracy (%)	95.02	97.73	6.45	0.321
Day old chicks' weight (g)	37.36	37.19	0.56	0.496
Age at sexual maturity (d)	139.87	143.42	0.98	0.341
Mature body weight (g)	1896.64	1815.67	39.99	0.401
Average egg production (%)	80.22^{b}	82.47^{a}	0.612	0.020
Average egg weight (g)	65.30^{a}	60.36^{b}	0.491	0.001
Average egg mass (g)	51.87^{a}	49.78^{b}	0.487	0.005
Annual egg production (No)	292.83	301.01	12.94	0.068
Annual egg mass production (kg)	18.97^{a}	18.17^{b}	0.186	0.038
Average feed intake (g)	113.23	110.01	0.694	0.140
Average FCR	2.195	2.211	0.027	0.315

SEM, Standard Error of Mean. ^{a,b,c}Mean values within a column followed by the same letter are not significantly different (P>0.05)

Egg qualities

Internal egg qualities of Shorna and ISA Brown were presented in Table 2. The current study revealed non-significant (p>0.05) findings in most of the parameters, like albumen height, Haugh units (HU), yolk color, albumin index, eggshell breaking strength (ESBS), and yolk index excluding albumen width. Similar non-significant results came from the research of Rehman et al. (2017), who assessed the egg quality of commercial (Nick chick), White Leghorn (WLH), and Fayoumi (FAY) breeds of chickens. However, numerically, a higher albumen width was observed in Shorna (79.63) than in ISA Brown (74.15). The cause behind this significantly higher result might be due to the greater weight of individual eggs in the BLRI developed layer strain and thus an increased relative proportion of albumen, which is allied with a rise in egg width (Hocking et al, 2003). Though the ESBS and HU were not noteworthy, the mathematically higher rate was found in the profitable ISA Brown. These capacities may be due to laying more eggs and therefore demanding more labile pools of calcium in their medullary bones to form eggshell (Prondvai, 2017) in the Shorna strain. In another experiment, Hocking et al., (2003) and Ahmad, (2013) mentioned that genetic variation between breeds/strains for eggshell strength was low, which agrees with the present findings. Previously, Ragheb et al. (2013) found lower albumen heights, yolk heights, and Haugh units for ISA Brown and Hy-line brown laying hens than the present findings. These variations might be due to the age of the bird, feeding, management, egg production, egg weight, and environmental conditions during the experiment. Despite this, the eggs laid by Shorna had a much greater yolk weight (YW, mm) in comparison to those laid by ISA Brown, which is consistent with the findings of Rehman et al. (2017).

Table 2. Effect of strain on egg qualities of laying hens

	AH (mm)	AW (mm)	AI (%)	YC	YH (mm)	YW (mm)	YI (%)	HU	ESBS (kg/cm^2)
Shorna	8.81	79.63^{a}	11.06	6.58	19.02	41.03	46.35	91.76	3.84
ISA Brown	9.25	74.15^{b}	12.56	6.36	19.12	40.19	47.58	95.22	4.03
SEM	0.185	0.97	0.335	0.081	0.207	0.216	0.523	1.094	0.121
P value	0.214	0.002	0.157	0.281	0.321	0.426	0.078	0.914	0.140

SEM, Standard Error of Mean, ^{a,b,c}Mean values within a column followed by the same letter are not significantly different (P>0.05), AH, albumen height; AW, albumen width; AI, albumin Index; YC, yolk color; Yolk height; YW, yolk width; YI, yolk index; HU, Haugh unit; ESBS, eggshell breaking strength.

Blood properties

Figure 1 displays the serum calcium (Ca), phosphorus (P), and magnesium (Mg) contents of the Shorna and ISA Brown laying strains. The P contents of Shorna were significantly higher than those of the commercial ISA Brown strain, even though the strain had no effect on serum Ca and Mg levels. Although Khawaja et al. (2012) examined the blood calcium, magnesium, and phosphorus levels of Deshi with commercial strains, they discovered no discernible differences between the treated birds under an intense production system. In addition, Pavlik et al. (2009) reported that nasty standards of plasma P in placing hens reduced slowly from the commencement of the arranging sequence to the end of laying (seventy-five weeks), which corresponded with the current outcomes. However, Boorman and Gunaratne (2001) stated that there was, in fact, no relationship between plasma P levels and eggshell weight. Research has established that the accumulation of plasma Ca is linked to declining eggshell strength and depth (Pavlik et al., 2009). They added that the lower plasma calcium levels were connected to increased egg production and vice versa. The present study results, although non-significant, were supported by these findings as lower plasma Ca levels in relatively higher egg-producing ISA Brown chickens resulted in better eggshell quality than that of the Shorna strain. Although Hester et al. (1980) and Jerabek et al. (1993) observed that declining blood plasma Ca levels had no significant influence on eggshell quality. Table 3 displays the biochemical measurements (mg/dL) of triglycerides (TG), high-density lipoprotein (HDL), and total cholesterol (TCL) in Shorna and ISA Brown laying strains. The results of the current study were consistent with Khawaja et al. (2012) in that there was no statistically significant variation in these values between the strains. Numerically, in the present study, we obtained higher TG levels in commercial laying lines than relatively lower levels in Shorna. This is because selective breeding increases the lipogenic activity of the liver, which is triggered by endogenous estrogens (North and Bell 1990). According to Musa et al. (2007) the rise in high-density lipoprotein (HDL) in plasma serum was linked to a rise in triglycerides (TG), very low-density lipoprotein (VLDL), total cholesterol (TCL), and a diminution in the level of low-density lipoprotein (LDL). They also stated that the levels of serum total cholesterol (TCL) and high-density lipoprotein (HDL) were meaningfully advanced in the thinner breed, which was also reversed by the present outcome. Although the strain's H: L relation was not suggestively pretentious (P > 0.05), its HI antibody titer (log 2 base) in serum was prejudiced, and its higher strain level than that of a viable ISA brown strain indicated that it is malleable, understanding the conservational condition.

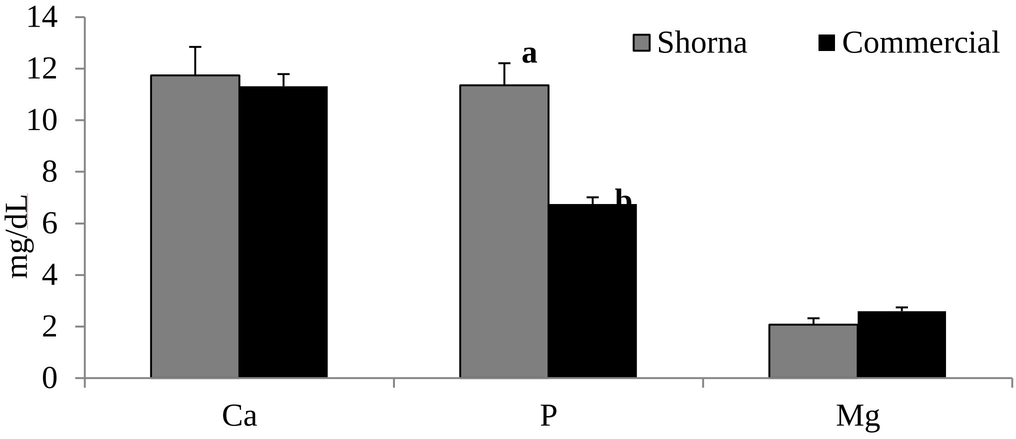

Figure 1. Serum calcium (Ca), phosphorus (P), and magnesium (Mg) contents of the Shorna and ISA Brown laying strains.

Table 3. Effect of strain on blood properties of laying hens

	TG (mg/dL)	TCL (mg/dL)	HDL (mg/dL)	H:L ratio	HI antibody titer (log2base)
Shorna	930.4	97.45	37.3	0.466	6.62[a]
ISA Brown	1050.35	109.86	36.05	0.457	5.97[b]
SEM	221.38	32.10	5.45	0.031	0.435
P value	0.215	0.329	0.871	0.247	0.037

Values are mean±SE. TCL, total cholesterol; TG, triacylglyceride; HDL, high density lipoprotein.

Ovarian morphology

As shown in the current experiment (Table 4), strains influenced the quantity of ovarian follicles in laying hens. As a result, more follicles (1-3 mm, 3–4 mm, and 10–12 mm-sized follicles) developed in the Shorna strain than in the ISA Brown strain. These large white follicles (LWFs) and small yellow follicles deliver a continuous source of mounting follicles for the grading (Gilbert et al., 1983), and these advanced follicles form yellow-yolky follicles in the ovary and lastly affect resting rate. However, there were no appreciable effects of stress on the combined weight of big follicles, ovary weight, or stromal weight. Due to a lack of earlier research concerning this strain, the shortest judgment was not likely with the present outcomes.

Table 4. Effect of strain and temperature on ovarian morphology of laying hens

Layer Strain	OW (g)	TLYFW (g)	SW (g)	Follicle number					
				1-3 mm	3-4 mm	4-6 mm	6-7 mm	7-9 mm	10 to above
horna	53.21	46.29	5.98	37.14[a]	12.62[a]	9.37	4.67	3.12	7.15[a]
ISA Brown	52.19	38.59	5.49	34.18[b]	7.43[b]	7.39	4.56	2.98	6.25[b]
SEM	1.462	1.909	0.329	2.33	0.814	0.794	0.406	0.329	0.188
P value	0.434	0.179	0.671	0.041	0.005	0.157	0.889	0.496	0.005

SEM, Standard Error of Mean.[a,b,c]Mean values within a column followed by the same letter are not significantly different (P>0.05),OW, ovary weight; SW, stroma weight; TLYFW, total large yellow follicle weight

Conclusion

In conclusion, BLRI-developed layer strain Shorna was found to be better compared to commercial strain ISA Brown considering its egg production performances, external and internal egg quality, and biochemical measurements. Therefore, the present results indicated that the BLRI-developed layer strain named Shorna may be replaceable with the commercial strain ISA Brown, attributing laying performances, but needed more farmer-oriented research to make a concrete recommendation.

Conflict of interest

To publish this scientific study, the authors state that they have no conflicts of interest.

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