

Effects of Age, Rearing System and Their Interaction on Phenotypic Characteristics in Hisex Brown Laying Hens



BY

Lipi Akter

Intern ID: G-67

Roll No: 09/44

Registration No: 454

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Effects of Age, Rearing System and Their Interaction on Phenotypic Characteristics in Hisex Brown Laying Hens



Approved as to style and content by

.....

Signature of Supervisor

DR. Omar Faruk Miazi

Associate Professor

Department of Genetics and Animal Breeding

Faculty of Veterinary Medicine

Chittagong Veterinary and Animal Sciences University, Khulshi-4225

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The author,

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LIST OF ABBREVIATIONS AND SYMBOLS USED

Abbreviation and symbol	Elaboration
%	Percent
/	per
±	plus-minus
^o C	<i>Degree Celsius</i>
BBS	Bangladesh Bureau of Statistics
DLS	Directorate of Livestock Services
FAO	Food and Agriculture Organization
FPLS	Federal Parent Locator Service
hrs	Hours
IFPRI	International Food Policy Research Institute
Kcal	Kilo Calorie
Kg	Kilogram
Ltd.	Limited
mg	milligram
<i>ml</i>	milliliter
mm	millimeter
n	Number
SI	Egg Shape Index
www	World Wide Web
β-lactamase	Beta-Lactamase

ABSTRACT

The study was conducted in a commercial poultry farm in Quaish under Chittagong district to observe the effects of age and rearing system on phenotypic characteristics Hisex brown layer strains. Several phenotypic characteristics along with egg quality traits Hisex brown were studied. One hundred cage and one hundred litter reared hens were randomly selected. Feed and water were available ad libitum. Eggs were sampled in three age periods, from 20 to 26 weeks, 37 to 43 weeks and 54 to 60 weeks of age. No observable difference was found in plumage color, beak color, shank color, comb color, comb type and egg color in both rearing system. Significant ($P<0.05$) difference was found in shank length, egg weight and body weight and in cage rearing system it was 3.32 ± 0.16 , 59.44 ± 0.42 and 1851.60 ± 11.93 , respectively where in case of litter system it was 3.19 ± 0.01 , 61.14 ± 0.45 and 1849.10 ± 33.90 , respectively. Egg quality characteristics were affected by rearing system and age. Egg weight, yolk weight and percentage increased with the hens' age in both systems, but Egg shape Index decreased with age. The highest egg weight ($61.14\pm 0.45\text{g}$) was found in litter rearing whereas highest yolk percentage ($28.12\pm 0.17\%$) was found in cage system at the final observation. It can be concluded that rearing system and age has effect on egg quality and any commercial layer strain improvement program should incorporate production objectives and trait performance of the society.

Key Words: Hisex Brown, Rearing system, Egg quality, Layer strain

Chapter I

INTRODUCTION

Bangladesh is an agricultural based densely populated country. About 71% of the population lives in rural areas (BBS, 2010a). The average per capita income is only US\$751 (BBS, 2010b). The majority of people are engaged in agricultural operations, particularly crops, fish and livestock, of which both native and exotic poultry are now mainstream. Approximately 20% of the protein consumed in developing countries comes from poultry meat and eggs (Alders and Pym, 2009).

As an important sub-sector of livestock production, the poultry industry in Bangladesh plays a crucial role in economic growth and simultaneously creates numerous employment opportunities. The poultry industry, as a fundamental part of animal production, is committed to supplying the nation with a cheap source of good quality nutritious animal protein in terms of meat and eggs. Two main systems of poultry production are common in Bangladesh nowadays: commercial poultry production – where birds are kept in total confinement and traditional scavenging or semi-scavenging poultry production (Das et al., 2008).

Commercial broiler farming, nowadays, has become a promising and dynamic industry with enormous potential and serves as a tool for poverty reduction through self-employment and income generation of unemployed family members (Raha, 2007). Due to short life cycle, low capital investment and quick return it may be a good source of income to rural farmers throughout the year (Bhende, 2006). It plays a significant role in improving the livelihood of the farmers that is reflected in improved socio-economic conditions and increased empowerment of women among rural people of Bangladesh (Rahaman et al., 2006). Approximately 70% of people are suffering from malnutrition and about 81% of families do not have their caloric requirements met in Bangladesh. In addition, about 60% of families in Bangladesh are not able to meet their protein requirements from their diets. Consumption of protein of animal origin is much lower in the country than in some other countries of the world. This was also echoed recently by Das et al. (2008). According to a recent report, the average per capita availability of meat is 23.6 g/ head/day compared against the standard human requirement of 120 g/head/day (BBS, 2010).

Approximately 20% of the protein consumed in Bangladesh originates from poultry. With the exception the dip in production due to the recent Avian Influenza outbreak, the growth of this

industry in terms of standards of commercialization, is very rapid. A gap still exists between the requirement and supply of poultry meat and eggs within the recent frame-work of the informal marketing system that is currently used. Among poultry species, the chicken population is dominant over others, at almost 90%, followed by ducks (8%) and a small number of quail, pigeons and geese. Free range 'backyard' and scavenging poultry, that are traditionally reared by rural women and children, still play an important role in generating family income, in addition to improving the family's diet with eggs and meat. Productive and reproductive performance of indigenous birds is relatively very low (35-40 eggs and 1-1.5 kg meat per bird per year), but genetic improvements by selective breeding, along with adequate nutrition and proper management, looks promising and quite possible. Commercial poultry production in Bangladesh, is conducted on an industrial scale and is growing tremendously in spite of recent difficulties but is expected to make a significant contribution to the economic development of the country (Das et al., 2008). Out of which, poultry plays an important role to fulfill the animal-source food (FAO, 2000; Permin and Pedersen, 2010). In Bangladesh, around 9% of total protein for human being consumption comes from livestock (DLS, 2012) and Poultry contribute 30% of animal protein and will increase to 40% within 2015 (IFPRI, 2000).

In Bangladesh about 150 hatcheries are producing around 4.56 millions of day old chicks (DOC) per week, about 70,000 commercial layer farms supplying 4,056 millions of table eggs per year (DLS, 2012). In year of 2007-2008 was Tk. 98253 million in which share of broiler farms was 36.97%, layer farms, 42.69%; hatchery, 9.83%; duck, 2.24%; and mixed farm, 8.28 % (FPLS, 2010). Different types of poultry farm in 2006-2008 in total were: Broiler farm 33225, layer farm 10099, hatchery 227, duck farm 5524, mixed 750 and total 49825. Percentage of existing poultry farms in 2006-2008: Broiler 28 %, Layer 23 %, hatchery 2 %, Duck 14 %, Mixed 6 %. The annual growth rate of all farms in 1995-2008 was 22%, during that time the annual growth rates for different types of farms were as broiler 28% (FPLS, 2010).

The genotype affects mainly egg weight and eggshell characteristics. Several studies have shown heavier eggs in brown hens than in white ones (Halaj and Grofik 1994; Ledvinka et al. 2000; Leyendecker et al. 2001a; Vits et al. 2005). Baumgartner et al. (2007) reported a significant effect of age on egg weight in the Leghorn type hens. Egg weight influences the weight of its components as well. The correlations between the egg weight and the albumen weight, yolk weight, eggshell weight are high and range from 0.67 to 0.97 (Zhang et al.

2005). Harms et al. (1990) reported the range of correlation between egg size and eggshell thickness as 0.92– 0.97. The egg shape index can also be affected by the genotype (Tůmová et al. 2007). Egg shape index in the white hens Shaver Starcross 288 was higher than in the brown Moravia SSL (Halaj and Grofík 1994).

Heritability of the yolk weight is 0.45 (Zhang et al. 2005), 0.22 (Hartmann et al. 2000). The eggshell quality is given through its weight and percentage of the eggshell, thickness and strength. The main differences in eggshell quality depend on the way of breeding, strain or pure lines. Egg weight directly affects the egg size and shell thickness. For instance brown hens D 102 had a higher shell weight in comparison with lines of White Leghorn (Ledvinka et al. 2000).

The age of hens is another of the factors influencing egg weight. Peebles et al. (2000), Silversides and Scott (2001), Oloyo (2003), Van den Brand et al. (2004), Rizzi and Chiericato (2005), Johnston and Gous (2007) showed that the egg weight increased with the hens' age. On the other hand, Zemková et al. (2007) demonstrated that the egg weight was not influenced significantly by age. The age of hens also increased yolk weight (Rossi and Pompei 1995; Suk and Park 2001; Van den Brand et al. 2004), albumen weight (Rossi and Pompei 1995; Suk and Park 2001) and yolk proportion (Rossi and Pompei 1995; Rizzi and Chiericato 2005), but decreased albumen percentage (Van den Brand et al. 2004; Rizzi and Chiericato 2005). The age of hens influenced the eggshell quality (Silversides and Scott 2001; Campo et al. 2007) which deteriorated with advancing age of hens. On the other hand, Yannakopoulos and Tserveni-Gousi (1987) observed that the eggshell was thicker with hens' age, while Yannakopoulos et al. (1994) found no significant effect of the age of hens on eggshell characteristics. No effect of age on eggshell thickness was found by Van den Brand et al. (2004) and the shape index of the eggs decreased with age. The eggshell traits may be affected by interactions of age and breed (Campo et al. 2007).

Egg quality is influenced by many internal and external factors, of which genotype, housing system and time of oviposition are of major importance. Egg weight is one of the most important characteristics because each of the components of the egg depends on egg weight (Hartmann et al., 2000). The proportion of yolk is negatively related to egg size but positively associated with hen's age (Hartmann et al., 2000; Johnston and Gous, 2007a).

In recent years in Europe there has been a significant trend to develop and use alternative housing systems rather than cages. Data from a number of studies revealed differences in egg

quality depending on the housing system. In many cases, results are contradictory. Moorthy et al. (2000), Leyendecker et al. (2001) and Jenderal et al. (2004) reported higher egg weights in cages, while Tůmová and Ebeid (2005), Pištěková et al. (2006), Zemková et al. (2007) recorded heavier eggs on litter. Quality traits such as eggshell thickness, Haugh unit score and yolk index were reported to be higher in cages than on deep litter (Moorthy et al., 2000; Tůmová and Ebeid, 2005, Lichovnicková and Zeman, 2008). Egg quality in different housing systems is also influenced by genotype. Leyendecker et al. (2001) reported genotype and housing system interactions between Lohmann LSL and Lohmann Brown housed in conventional cages, aviaries or intensive free-range housing. Vits et al. (2005) pointed out that eggshell quality characteristics were lower in enriched cages than in conventional cages, and that Lohmann brown hens showed better results compared to Lohmann LSL.

The monitoring of egg quality characteristics is important mainly in terms of production economy. The attention is devoted especially to eggshell quality, because cracked eggshell presents higher losses for market-egg producers. Therefore, it is very important to evaluate the egg quality characteristics and factors affecting them. The genotype and age are the most important factors, influencing not only egg weight but also other egg characteristics.

The objective of this study was to

1. Determine the effect of age on phenotypic characteristics of Hisex Brown strain
2. Determine the effect of rearing system phenotypic characteristics of Hisex Brown strain
3. Measure any possible interaction between these effects

Chapter II

MATERIALS AND METHODS

The study was conducted on commercial layer farm at Quaish under Chittagong district. They reared about 27000 layers of Hisex brown in ten shed and in five shed birds are reared in cage system and in another five shed birds are reared in deep litter system. They have separate shed for rearing day old chick from brooding to pullet. In brooding shed, they provided feed adlibbed which contains 21% CP and 2900 kcal ME/kg up to 8 weeks and 16% CP and 2650 kcal ME/kg up to 18 weeks and in layer 17% CP and 2750 kcal ME/kg up to 72 weeks. The birds were vaccinated against Mareks, Newcastle, Fowl cholera, chicken pox and Gumboro diseases.

2.1. Study population

The present study was conducted on layer strains of Hisex brown reared in a commercial poultry farm. A total of 100 birds from each rearing system were examined where population was formed by 27000 birds.

2.2. Study area

The study was conducted on commercial layer farm at Quaish under Chittagong district.

2.3. Study period

The duration of study was nine month. March 10, 2015 to November 4, 2015.

2.4. Housing and management

The following conditions were observed and information's were collected from the farm:

- Brooding system.
- Lighting management system.
- Floor Space.
- Feeder and waterer.
- Feeding and Nutrition.
- Medication.

2.5. Collection of data

The farm was visited every day and used to look after the birds and collected the data by observation and interviewing with the manager of the farm. The following data were collected from the farm.

- a. Amount of Feed intake.
- b. Body weight gain.
- c. Shank length.
- d. Beak length.
- e. Egg weight
- f. Egg shape index
- g. Yolk weight
- h. Yolk Percentage
- i. Analysis of the Data.

2.5.1. Amount of Feed intake

The amount of feed intake (gm /bird/day) was measured by number of quails per feeder and amount of feed supply per day in the feeder and weighing of the remaining feed, Amount of feed intake is necessary to measure the FCR and Cost effectiveness per bird rearing.

2.5.2. Body weight gain

Body weight (gm /bird) was measured directly by Digital weighing balance once in a week by random selection of 25 male and 25 female quails. And it was recorded regularly; at that time nylon bag was used for restraining the quail, it was important to measuring the FCR and for fulfillment the objective.

2.5.3. Shank length

The shank length (cm) was taken as the distance between the foot pad and the hock joint, Shank length was measured by a simple role scale once in a week along with the body weight measurement for 25 male and 25 female quails.

2.5.4. Beak length

Beak length (cm) was also measured by the same simple role scale once in a week along with the body weight measurement and shank length measurement for 25 male and 25 female quails. Age at first lay: Duration of days between day old chicks to start of egg laying.

2.5.5. 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 electronic balance to the nearest 0.001 g. The shell thickness was determined according to Monira, Salahuddin, and Miah (2003). Shape index (SI) was determined using the following equation (Anderson et al., 2004)

$$SI = \frac{W}{L} \times 100$$

2.6. Housing

The housing system was open sided house for layer and closed house for brooding chick.

2.7. In cage brooding

Each chick guard contains 1200 chicks where space was 720square feet, contains electric brooder or gas brooder. It will be increased according to age and up to 16 weeks of age.

2.8. Watering

For the prevention of diseases clean water and germ free water were supplied to bird and each 75 birds need one round drinker and after 3 days later used nipple drinker (one nipple drinker for 8 to 10 birds) with round drinker.

2.9. Feeding and feeder

The experimental farm supplied feed to Day old chick (DOC) on especial flat feeder for 2 days. Then provide linear feeder @ 2.5 cm/bird. The starter rations start after 24 hours of arrival and contained CP 19 to 20%, ME 2950/kg, lysine 1.07, methionine 0.43 to 0.54%. Adlibitum feeding was allowed for 3 weeks. Then weighing which compared with guide line. The ration maintained for layers are mentioned below:

Table 1: Composition of ration supplied to layer birds

Ingredients	Amount	Calculated Nutrients	Percentage (%)
Maize	64kg	CP	18.73
Rice Polish	6kg	ME (Kcal/Kg)	2830.22
Soyabean meal	18kg	Crude Fiber	4.22
Oil Cake	2kg	Ether Extract	5.18
Propack/PL-68	6kg	Ca	3.965
Limestone	4kg	P	0.97
DCP plus	300gm	Methionine	0.47
Cevit GS	250gm	Cystine	0.79
Methionine	100gm	Lysine	0.91
Lysine	75gm		
Choline	50gm		
Salstop	200gm		
Allitox	200gm		
Zymax	50gm		
Gut Care	50gm		
Tocomin Plus	50gm		
Biogold P	100gm		
Diconil	50gm		

2.10. Lighting

Lighting schedule followed in this farm is given below in table

Table 2: lighting schedule were @ watt/ sq.ft

Age/day/week	Light/day(in hour)	Watt/sq.ft
1-3day	24hours	0.56 watt
4-6day	23 hours	0.50 watt
7-8day	23 hours	0.37 watt
1-2weeks	23 hours	0.25 watt
2-3weekas	22 hours	0.19 watt
3-4weeks	18 hours	0.19 watt
4-5	16 hours	0.19 watt
5-6	14 hours	0.19 watt
6-10	13 hours	0.19 watt
11-18	12 hours	0.095 watt
18-20	11.30 hours	0.019 watt
20-21	12 hours	0.25 watt
21-22	12.30 hours	0.25 watt
22-23	13 hours	0.25 watt
23-24	13.30 hours	0.25 watt
24-25	14 hours	0.25 watt
25-26	14.30 hours	0.25 watt
26-27+weeks	16 hours	0.25 watt

2.11. Data analysis

Collected data was edited and stored in Microsoft Excel. Mean with standard error of different traits were estimated by PROC GLM and PROC MIXED of SAS (SAS, 2008) by using the following design according to (Steel et al., 1997).

Where,

Y_{ijk} = the observed value of a given individual;

μ = the overall mean for trait;

T_i = effect of weeks;

S_j = effect of rearing system; and

e_{ijk} = the random error associated with the measurement of each individual distributed as $N(0, \sigma^2)$.

Mean differences were obtained by least significant differences (LSD) at 5% level of significance (Steel et al., 1997).

Chapter III

Result and Discussion

The study was conducted in commercial poultry farm of Quaish under Chittagong district in Bangladesh. The parameters which are related to this study about cage and litter type reared commercial layer strains were collected by observing, handling, restraining and measuring of different phenotypic parameters.

Table 3: Value of different phenotypic variables in different age and rearing systems

Variable	Rearing System	Week of Laying			P – value
		20-26 Mean ± SE	36-42 Mean ± SE	54-60 Mean ± SE	
Shank length	Cage	2.91±0.01	3.17±0.11	3.32±0.16	0.00
	Litter	2.93±0.00	3.11±0.03	3.19±0.01	
Beak length	Cage	1.99±0.01	2.02±0.01	2.09±0.05	0.533
	Litter	1.98±0.05	2.02±0.01	2.07±0.00	
Egg weight (g)	Cage	55.44±0.34	57.53±0.47	59.44±0.42	0.00
	Litter	53.82±0.45	59.44±0.54	61.14±0.45	
Egg Shape Index (%)	Cage	78.52±0.99	76.64±0.87	75.09±0.77	0.067
	Litter	78.94±0.69	76.88±0.74	75.34±0.81	
Yolk Weight (g)	Cage	12.46±0.33	16.86±0.56	17.19±0.76	0.782
	Litter	12.94±0.17	16.71±0.34	17.98±0.75	
Yolk (%)	Cage	23.12±0.19	26.94±0.31	28.12±0.17	0.312
	Litter	23.53±0.12	26.93±0.17	27.76±0.21	
Age at first lay	Cage	143±0.51			0.834
	Litter	141±0.58			
Body weight	Cage	1781.60±11.18	1826.60±12.1	1851.60±11.93	0.036
	Litter	1786.10±27.93	1826.10±31.09	1849.10±33.90	

The egg weight increased with the layer's age in both rearing systems (Table 3). These results are in agreement with Peebles et al. (2000), Silversides and Scott (2001), Oloyo (2003), Van den Brand et al. (2004), Rizzi and Chiericato (2005), Baumgartner et al. (2007), Johnston and Gous (2007) who showed that egg weight increases with the age of hens.

Several interactions between the rearing system and hen's age were found. The cage type had a significantly ($P \leq 0.001$) higher egg weight (55.44 g) than the litter (53.82g) at the beginning of the experiment, but at the end of the experiment litter system produced the heaviest eggs (61.14 g). The quality of yolk is given by yolk weight and its percentage. Both of these variables increased with age in both rearing system. The highest ($P > 0.05$) yolk percentage was at the age 54 to 60 weeks in cage rearing system (28.12%) in comparison with eggs of litter system (27.76%). Rossi and Pompei (1995), Suk and Park (2001), Van den Brand et al. (2004), Tůmová and Ledvinka (2009) confirmed that the yolk weight and yolk percentage (Rossi and Pompei, 1995; Rizzi and Chiericato, 2005) significantly increased with the hens' age, which is in agreement with our result. Moorthy et al. (2000), Leyendecker et al. (2001) and Jenderal et al. (2004) reported higher egg weights in cages, while Tůmová and Ebeid (2005), Pištěková et al. (2006), Zemková et al. (2007) recorded heavier eggs on litter.

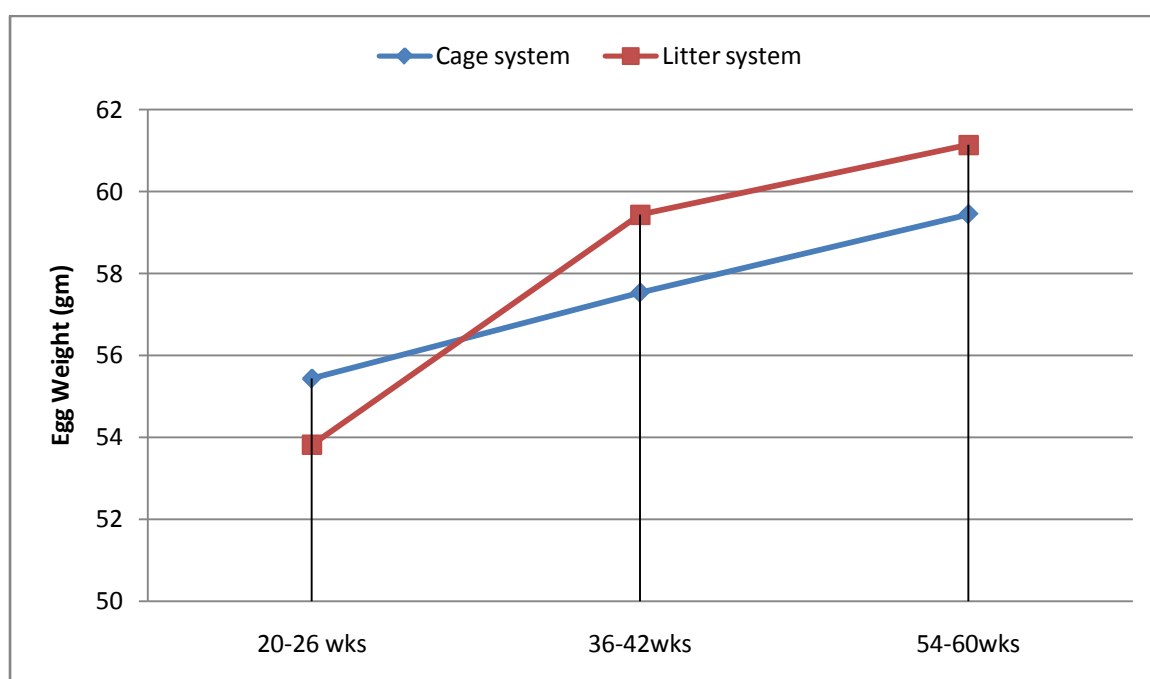


Figure 1: Effects of age and rearing system on Egg weight

Feather color of cage and litter system reared chickens was found brown in color. No difference in plumage color between two rearing system was found.

In cage type and litter type chickens, the color and type of comb was found reddish and single type which is agreed by other researchers (Anonymous, 2015; Halima et al., 2007a). No difference in color and type of comb between two rearing system was found.

The Shank color of cage type hen was found yellowish which was similar to litter type that is agreed by other investigators (Guni and Katule, 2013; Anonymous, 2015). No difference in shank color between two types of bird was found.

Yellowish color beak was found in both cage and litter type layers which is agreed by Hendrix Genetic Company limited (Anonymous, 2015).

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

Shank length of cage reared layers is significantly ($P < 0.05$) higher than litter type for all age group. In cage type, it was found 3.32 ± 0.16 which is nearly similar to Olawunmi et al (2008), but in litter type, it was found 3.19 ± 0.01 , which is also nearly similar to Olawunmi et al. (2008).

Cage and litter type layers are not similar in beak length. The beak length of both types bird was 2.09 ± 0.01 and 2.07 ± 0.00 , respectively.

In this study, the mean egg shape index (SI) values were 78.52 ± 0.99 and 78.94 ± 0.69 for the eggs of cage and litter type layers, respectively in initial observation. In final observation it was 75.09 ± 0.77 and 75.34 ± 0.81 , respectively. In both rearing system SI was decreased with age. Rossi and Pompei (1995), Suk and Park (2001), Van den Brand et al. (2004), Tůmová and Ledvinka (2009) confirmed that the yolk weight and yolk percentage (Rossi and Pompei 1995; Rizzi and Chiericato 2005) significantly decreased with the hens' age, which is in agreement with our result.

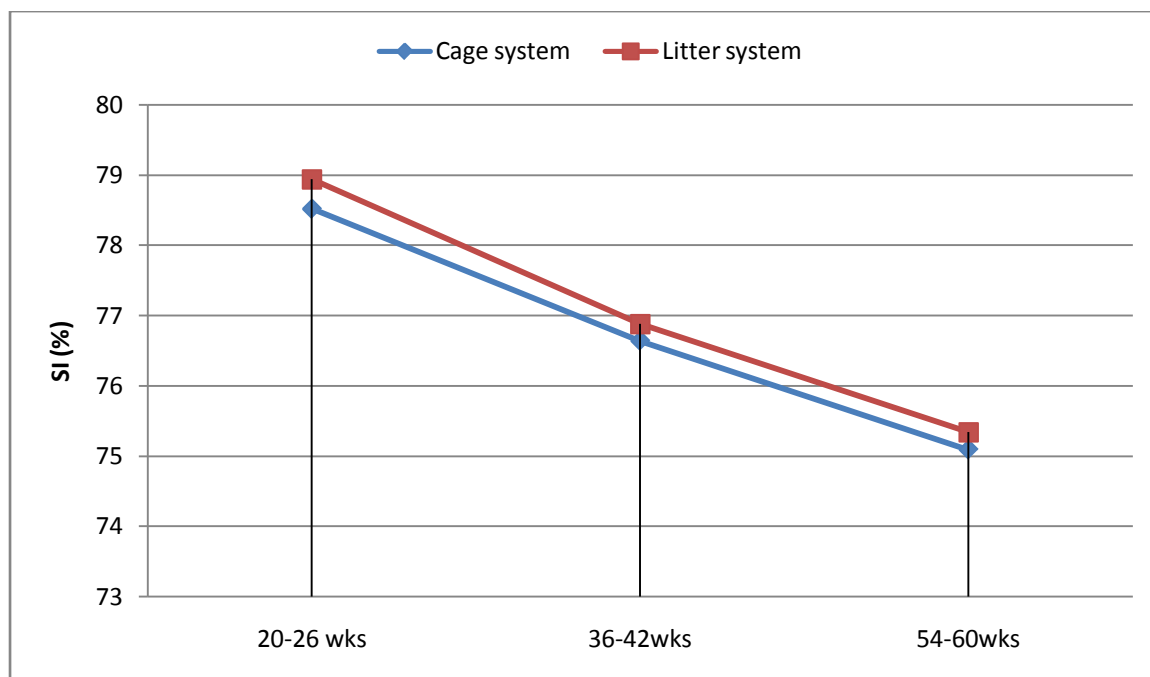


Figure 2: Effects of age and rearing system on Egg Shape Index

Average age at first laying of cage type is insignificantly ($P > 0.05$) dissimilar with litter type. The average age of first lying of cage type was found 143 ± 0.51 days which is agreed by others (Kabir and Gaque, 2010); but it was higher than recommended level of Hendrix Genetic Company limited (Anonymous, 2015). In litter type, it was 141 ± 0.58 day which is also nearly agreed by Kabir and Haque (Kabir and Gaque, 2010); but it is higher than than recommended level of Hendrix Genetic Company limited (Anonymous, 2015). Variation with company level might be due to managerial causes.

In this study, the average body weight of cage type layers was found significantly ($P < 0.05$) higher than litter in the later observation but it was vice-versa in initial observation. In cage type layers, body weight was found 1851 ± 11.93 g, which is nearly agreed (1854.9g) by Nagle et al (Anonymous, 2014) and it is nearly similar to recommended level of Hendrix Genetic Company limited (Anonymous, 2015) at 50 weeks of age and in case of litter type layers, it was 1849.10 ± 33.90 g which is also nearly similar (1854.9g) to (Anonymous, 2014) and it is nearly similar to recommended level of Hendrix Genetic Company limited (Anonymous, 2015) at 50 weeks of age.

Conclusion

Population of commercial layer strain in Bangladesh is increasing. Chicken is only species that is expected to be found in village that serves as a source of income and nutrition. Therefore emphasis should be given from stakeholders (policy makers, research and development bodies) to keep chicken population. Bangladesh has diversified agro-ecologies that may be attributing for the presence of diversified phenotypic appearance of commercial layer strain. Most communities from different parts of a country have been attaching their social believes and life with such morphological characteristics of commercial layer chicken. This may create influences on the market values of poultry. Thus any breeding and improved production program of the commercial layer should therefore, incorporate the production objectives and trait performances of the society. By improving the approaches and traditional management of commercial layer, better performance always been achieved from these birds. Hence, these huge gene pool should be protected from genetic erosion and apply for improvement through scientific selection together along with technologies of genomics.

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