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Effect of Egg Storage Periods on Egg Weight Loss, Hatchability and Growth Performances of Brooder and Grower Leghorn Chicken

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Abstract: *The experiment was conducted to determine the effect of egg storage periods on egg weight loss, hatchability, hatchling weight and subsequent performances of leghorn. A total of 576 eggs were collected from similar ages of layers and randomly grouped into three storage periods of 0, 5 and 10 days with three replications, each contained 192 which were randomly sub-divided into three replicates of 64 eggs in a CRD. The chicks that hatched on the same day (21) were counted, weighed individually at hatch and the percentage hatchability was calculated. The chicks were intensively raised on deep litter system for 12 weeks on a similar diet, but kept separately according to the initial treatment of the eggs. Data were summarized using SAS and means were separated using Duncan's multiple-range test. This study showed that egg storage periods strongly influenced all parameters measured during all the studied periods. It has significant effect on egg weight loss, hatchability, day-old weight, body weight, weight gain, feed conversion and mortality. From this study, it can be concluded that as the egg storage period increase, eggs loss more weight, hatchability rate reduces, brooder and grower live weight, weight gain and survivability would be decreases whereas feed conversion ratio increases. Therefore, it is not good to store leghorn eggs for more than 5 days as it increases egg weight loss and chick mortality, reduces hatchability and growth performances, and requires more feed to grow.*
Keywords: *chicks, egg, performances, storage period, White leghorn*

I. Introduction

Storage of hatching eggs is an indispensable part of hatchery operation, even though storage length and conditions may influence embryonic viability. Authors [1] reported that the effect of egg storage on embryonic viability depend on storage time duration, environmental conditions, hen age and strain of breeder. Pre-incubation factors that determine embryo and eggshell quality include parental genetics, nutrition, maternal age, and environmental conditions such as weather and lighting [2] as well as methods of egg collection and egg storage period [3]. Egg storage conditions prior to incubation can influence hatchability and are thus of considerable concern to commercial hatchery practice [4]. There are strong positive correlations among pre-incubation egg weight, storage periods, chick weight and subsequent performance of different kinds of poultry [5,3]. Domestic poultry and waterfowl eggs generally lose 11 to 15% of their initial weight during incubation [6], although weight loss averages for various species can range from 10 to 23% [7]. Fertility and hatchability are the major determinant of profitability in a hatchery enterprise [8]. Hatching eggs are frequently stored on breeder farms and at hatcheries to reduce transportation costs or to provide for sufficient eggs available to fill large incubators. However, the storage of eggs for more than a week is known to increase embryonic abnormalities and mortality due to the degradation of the viscosity of egg albumen [9]. The elongated storage of eggs also shows reduced hatchability and increase in the amount of incubation time required to hatch. In fact, a rule-of-thumb in the hatchery business in that for every day after 10-days of storage, hatchability will decrease by 1 % [10]. The storage period before incubation at Haramaya University poultry farm and other hatchery industries in eastern Ethiopia is more than weeks, and hatchability percentage in these industries is very low (unpublished document from Haramaya University poultry farm). This elongated egg storage problems on hatchability and growth performances of brooder chicks is not extensively determined in eastern Ethiopian conditions, as hatchability and growth performances of chicks differs according to species, breeds, environmental conditions and other managements. This study will help hatchery industries to understand the effect of pre-incubation periods on egg weight loss, hatchability, hatchling weights and its effects on growth performances. Therefore; the objective of this study were to verify an effect of pre-incubation egg storage periods on egg weight loss, hatchability, hatching weight and growth performances for white leghorn chicken during 12 weeks brooding periods.

II. Material and Methods

Description of the Study Area: The experiment will be conducted at poultry farm of Haramaya University, located 505 km east of Addis Ababa. The site is situated at an altitude of 1980 meter above sea level, 9^{0} 26 ' N latitude and 42^{0} 3' E longitude. The area has an average annual rainfall of 741.6 mm. The mean annual minimum and maximum temperatures are 8.25^{0}C and 23.4^{0}C, respectively.

Egg collection and storage periods: A total of 576 eggs were collected from similar ages of white leghorn layers and randomly grouped into three storage periods of 0, 5 and 10 days with three replications each. Eggs were collected twice a day at 11:00 am and 4:00 pm and selected based on shape, free of shell cracks and immediately weighed individually using sensitive weighing scale and stored for respective days in cold room with unspecified temperature and relative humidity.

Egg Weight Loss during Pre-Incubation Storage: Egg weight loss during pre-incubation storage periods was measured by subtracting fresh egg weight measured on the same day of collection from egg weight measured at the end of storage periods before incubation except for fresh eggs (0 days storage).

Egg Incubation and Its Managements: All eggs were individually placed into a tray with the broad ends pointing upwards and incubated once at 37.5 °C and 75 % relative humidity for eighteen (18) days during which the tray was placed at an angle of 90° with no rotation. On the 18^{th} day of incubation, the eggs were transferred at once into the same Hatcher. A temperature of 36°C and relative humidity of 65 % will be provided for the last three days. The chicks that hatched on the same day (21) were counted, weighed on a sensitive balance and the percentage hatching yield and hatchability were calculated.

Pen Preparation and Management of Experimental Chicks:

In the second part of study, all normal chicks hatched from each treatment were maintained for subsequent growth trial. Pens, watering and feeding troughs were thoroughly cleaned, disinfected and sprayed before placing the experimental chicks in the pen (2.5 m by 1.5 m). In each pen two infrared lamps suspended at appropriate height prior to chicks transferred to give appropriate warmth. Each infrared was on 24hrs. Chicks hatched from similar storage periods or groups were grouped in to the same treatment (pen), to correlate growth performance with egg storage periods and hatchling weight. The chicks were intensively raised on deep litter system for twelve (12) weeks in the poultry unit of the teaching and research farm of Haramaya University. The litter materials used was wood shavings or saw dust. On the first day of hatching, chicks provided water with vitamin premix (15gm vitamin premix in 10 litter water). On the second day of hatching, the chicks vaccinated against new castle disease and medications provided using broad spectrum antibiotics. Hatched chicks were reared on a similar diet and housed kept separately according to the initial treatment of the eggs. Feed and water will be given to the birds ad libitum. The experimental diet was composed of ground corn (44%), wheat short (25%), soybean (7.5%), peanut seed cake (20%), salt (0.2%), lime stone (2.3%) and vitamin (1%).

Body weight change: The live weight of birds was at hatching recorded as initial weight and weight gain calculated for every two consecutive weeks. Average live weight per bird was measured every 14 days by weighing the chicks in each pen and the total weight will be by the total number of birds in each pen. These live weights were used to calculate growth rate. The overall average body weight for each treatment was then computed by taking the average values.

Feed Intake: A weighed amount of feed was offered once daily at 7:30 am every day and refusal collected the next morning at 7:00 am and weighed after removing external contaminants by visual inspection and hand picking. Every two weeks feed offered was increased, as the age of chick's increases. The feed offer and refusal recorded for each group. The amount of DM consumed was determined as the difference between the DM offered and refused. Feed conversion ratio (FCR) is measured by dividing feed consumed into live weight gain within two consecutive weeks.

Mortality: Mortality was recorded daily during the study. Deaths after the onset of the experiment was recorded as mortality and expressed as percent mortality at the end of the experiment.

Statistical analysis: Data on egg weight loss, hatchability, hatching weight and growth performance were determined by using General Linear Model (GLM)) procedures of the statistical analyses system (SAS 2008). The statistical model will be used is: $Y_{ijk} = \mu + T_1 + \sum_{ijk,}$ Where: Y_{ijk} = the overall observation (egg weight loss, hatchability, Hatching weight and chick growth performance), μ = population means, T_1 = Effect of different storage period (0, 5 and 10 days), $\sum_{ijk}$ = Residual effect.

III. Results and Discussion

In this study eggs stored for 5 and 10 days at cold room with unspecified temperature and relative humidity losses its weight 1.62% and 3.27%, respectively (Table1). Lower weight loss reported for the same storage periods, in the study reported by [11] who stored eggs at 5ºC for 2, 5 and 10 days and observed 0.27%, 0.51% and 0.66% of egg weight loss during storage, respectively. This study agrees with those of [12, 13, 14, 15]. The influence of egg storage period on hatchability rate was found to be highly significant (P< 0.0001) as appeared in ANOVA. The rate of hatchability for fresh, seven and ten days storage periods were observed as 67.7, 68.23, and 54.69 percent respectively (Table 1). Duncan's Multiple Range Test shows that the shortest storage period (5 days) group had significantly (P< 0.05) largest hatchability rate than fresh and longest egg storage period. This result was in agreement with the study done by [16] in Turkey, who reported that influence of storage period (1-3 days, 6-8 days, 12-14 days) on the hatchability of fertile eggs values (66.5 %, 56.83 % and 18.93 %) was demonstrated to be highly significant (P< 0.01) and the extension of the storage period more than 8 days resulted in higher decreased hatchability values of fertile eggs. Besides, the study by [17] in Egypt reported that the best hatchability percentage was observed for groups of eggs stored for 4 days (76.27 %) as compared with other storage periods 2 days (72.12 %) and 6 days (71.81 %). Also, [18] reported that storage time linearly influenced hatchability. Longer periods of storage will increase the spread of time over which hatching takes place and this may influence the total hatchability as well the overall quality of chicks [12]. From this study, it can be concluded that as the storage period increase, the hatchability rate of fertile eggs would be decreases. The results of this study provide evidence that the leghorn eggs that stored longer than 5 days were detrimental to hatchability.

Significant differences were not found in hatchling weight at different egg storage time (Table 2). The finding that storage had no effect on one-day-old chick weights is in agreement with a previous report by [19, 20]. The findings of other workers [21, 22, 23], similarly reported that hatchling weight was not affected by storage period. This may be due to short storage period employed, different breeds, different storage system and weight of the eggs used in the above studies. In the present study, egg storage significantly (P<0.0001) depressed the body weight and body weight gain of leghorn chicks all through the brooding and growing periods (Table1 and 2). This was similar to [24, 19] who reported that the body weight hatched from eggs stored for a short period was higher than that when stored for longer periods. Also, [25, 26] have also established that the egg storage before incubation are fundamental factors that may affect poultry production parameters such as hatchability, chick quality, and broiler growth up to slaughter at 42 d of age. In this study, the effect of egg storage on body weight and body weight gain (BWG) at all ages of the brooding and growing periods, which was contrary to Alsobayel and Al-Miman (2010) who studied for 5 weeks and reported as egg storage had adverse effect on body weight and BWG that is pronounced at early stages.

The final feed conversion ratios (FCR) of chicks hatched from 5 and 10 days stored were significantly greater than those of chicks hatched from fresh eggs at brooder and grower age. This was in line to [27] who reported chicks hatched from one day stored eggs had better FCR than those hatched from 7 and 14 days at all age periods except 2-3 weeks. Storage period significantly (P<0.0001) influenced feed intake (FI) all through the brooding and growing age except from 2-6 weeks (Table 1 and 2). This result is partially agreed with [27] who studied for 5 weeks and reported that feed intake were significantly affected by pre-incubation storage at all age periods except at 0-3 weeks. There was also significant effect of egg storage on mortality of chicks and growers (Table 1 and 2). Currently, mortality during the rearing period was higher in chicks hatched from pre-incubation egg stored than from fresh eggs. In line to this study, [20] reported as deaths amongst broilers hatched from stored eggs was slightly higher than that from fresh eggs. Similarly, [9, 28] reported elevated mortality percentage as egg storage periods increased. Overall, mortality during the rearing period in this study was higher than 26.3%, the result obtained for Arbor acre strain by [9]. Throughout the rearing periods chicks exhibited recurrent outbreaks of disease with a symptom of wing droppings, closed one or both eyes and leg weakness but the specific disease type was not identified.

IV. Conclusion

From this study, it can be concluded that as the egg storage period increase, eggs loss more weight, hatchability rate of fertile eggs reduces, brooder and grower live weight, weight gain and survivability would be decreases whereas feed conversion ratio increases. Therefore, it is not good to store white leghorn eggs for 10 days as it increases egg weight loss and chick mortality, reduces hatchability and growth performances (BWG), and requires more feed to grow. It is also recommended that future work may also address the effect of storage period on similar parameters at pullet and layer stage performances and the nutritional value of ration should have been formulated to chick's and growers requirement to clearly evaluate effect of storage period on their performances and specific diseases which cause mortality should be identified.

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Table 1: Effect of Egg storage periods on egg weight loss and hatchability of leghorn chickens

Egg storage periods	Total Eggs (n)	Egg weight(g)	Egg weight loss(g)	Egg weight Loss (%)	Hatchability (%)
0 (Fresh)	192	49.86^{b}	-	-	67.70^{b}
5	192	49.27^{c}	0.80^{b}	1.62^{b}	68.23^{a}
10	192	49.87^{a}	1.63^{a}	3.27^{a}	54.69^{c}
SL	-	***	***	***	***

^{a,b,c} *Means with the same letter are not significantly different.*

Table 2: The effect of egg storage periods on the brooder performances of unsexed White leghorn

Parameters	**Age, weeks**	**N**	**Storage Periods**			
			0	**5**	**10**	SL
Day-old weight, g/bird	-	ZFT(0)	31.88[a]	32.49[a]	32.44[a]	NS
Body weight, g	**2**	ZFT (2)	65.06[a]	57.83[b]	54.52[c]	***
	4	ZFT (4)	99.44[a]	96.54[b]	95.33[c]	***
	6	ZFT (6)	130.10[a]	123.10[b]	118.70[c]	***
	8	ZFT (8)	193.70[a]	180.70[b]	179.30[c]	***
Body weight gain, g/bird	0-2	ZFT (0-2)	33.16[a]	25.27[b]	21.80[c]	***
	2-4	ZFT (2-4)	44.92[a]	37.50[b]	31.48[c]	***
	4-6	ZFT (4-6)	33.57[a]	23.62[b]	23.36[c]	***
	6-8	ZFT (6-8)	33.57[a]	23.63[b]	23.36[c]	***
Final weight gain, g /bird	0-8	-	131.80[a]	114.00[b]	109.50[c]	***
Average feed intake, g/bird/day	0-2	ZFT (0-2)	13.92[a]	13.49[b]	12.51[c]	***
	2-4	ZFT (2-4)	23.91[a]	23.50[a]	22.34[a]	NS
	4-6	ZFT (4-6)	37.01[a]	36.66[a]	34.96[a]	NS
	6-8	ZFT (6-8)	47.78[a]	47.62[b]	45.96[c]	***
Final feed intake, g/bird	0-8	-	122.62[a]	121.27[a]	115.77[a]	NS
Feed conversion, g/bird	0-2	ZFT (0-2)	0.41[c]	0.62[a]	0.49[b]	***
	2-4	ZFT (2-4)	0.77[a]	0.53[c]	0.59[b]	***
	4-6	ZFT (4-6)	1.11[c]	1.56[a]	1.50[b]	***
	6-8	ZFT (6-8)	1.42[c]	2.02[a]	1.97[b]	***
Final feed conversion, g/bird	0-8	-	0.93[b]	1.07[a]	1.06[a]	*
Mortality, %	0-2	ZFT (0-2)	14.04[c]	15.96[a]	17.98[b]	***
	2-4	ZFT (2-4)	5.56[c]	6.12[b]	7.23[a]	***
	4-6	ZFT (4-6)	3.68[c]	4.05[b]	5.76[a]	***
	6-8	ZFT (6-8)	2.68[a]	3.90[b]	4.53[c]	***
Final mortality,%	0-8	-	24.88[c]	31.99[b]	41.03[a]	***

Z, F and T-Number of chicks hatched from 0, 5 and 10 days storage each week. Z(0)-132, F(0)-121, T(0)-133,Z(0-2)-122, F(0-2)-115, F(0-2)-119, Z(2-4)-120, F(2-4)-113, T(2-4)-119, Z(4-6)-119, F(4-6)-110, T(4-6)-117, Z(6-8)-111, F(6-8)-109, T(6-8)-102, SL-Significance levels

Table 3: The effect of egg storage periods on sexed grower/pullet performances of leghorn

Parameters	**Age, weeks**	**N**	**Storage Periods**			
			0	**5**	**10**	SL
Body weight, g	8	ZFT (8)	193.70[a]	180.70[b]	179.30[c]	***
	10	ZFT (10)	246.93[a]	223.45[b]	205.56[c]	***
	12	ZFT (12)	266.67[a]	251.00[b]	243.60[c]	***
Body weight gain, g/bird	8-10	ZFT (8-10)	29.75[b]	66.23[a]	26.26[c]	***
	10-12	ZFT (10-12)	19.74[c]	27.55[b]	38.4[a]	***
Final weight gain, g /bird	8-12	-	72.97[a]	62.90[c]	71.70[b]	***
Average feed intake, g/bird/day	8-10	ZFT (8-10)	64.95[a]	64.20[c]	64.26[b]	***
	10-12	ZFT (10-12)	69.43[a]	53.08[c]	56.85[b]	***
Final feed intake, g/bird	8-12	-	134.40[a]	117.30[c]	121.10[b]	***
Feed conversion, g/bird	8-10	ZFT (8-10)	0.46[b]	1.03[a]	0.41[c]	***
	10-12	ZFT (10-12)	0.62[b]	0.13[c]	0.78[a]	***
Final feed conversion, g/bird	8-12	-	0.54[b]	0.53[c]	0.59[a]	***
Mortality, %	8-10	ZFT (8-10)	2.38[c]	3.76[b]	4.86[a]	***
	10-12	ZFT (10-12)	1.40[c]	2.90[b]	5.80[a]	***
Final mortality,%	8-12	-	3.78[c]	6.66[b]	10.66[a]	***

Z, F and T-Number of chicks hatched from 0, 5 and 10 days storage. Z(8)-102, F(8)-91, T(8)-196,Z(8-10)-102, F(8-10)-91, T(8-10)-96, Z(10-12)-93, F(10-12)-88, T(10-12)-90, SL-Significance levels