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EFFECT OF SOME MANAGERIAL FACTORS ON EGG QUALITY, CHEMICAL ANALYSIS AND HATCHABILITY OF LOCAL STRAIN LAYING HENS

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ABSTRACT:

*The objective of this study was to evaluate the effects of some managerial factors (storage of temperature and periods, as well as, covering system of eggs) on egg quality, chemical analysis of eggs, lose weight of eggs and hatchability, as well as, economical efficiency in laying Inshas hens at 42 weeks of age. A total number of 2052 eggs were obtained from Inshas hens **as** local strain 114 eggs in each treatment group. A factorial design was used (3 storage periods for 1, 4 or 7days (d) x 3 degree of temperature storage at 5°C, 16°C and at26°C x 3 covering system for without or covered by plastic layer in this study.*

The obtained results showed that increasing the storage period and temperature caused to decrease significantly (P< 0.05 and P<0.01) each of albumen%, Haugh units (HU), yolk index, moisture, ether extract, ash, crude protein, fertility and hatchability, while yolk%, lose weight of eggs, mortality of embryos at 11-18 and at 19-21 d. at increased significantly (P <0.05 and P<0.01) for eggs stored at 7 days or at 26^{o}C. Covering system eggs by plastic layer was the best than non- covered.

Interaction between stored periods, temperature storage and covering system showed that values of albumen weight %, shell weight %, HU, yolk index, chemical analysis of eggs in each of moisture, ether extract, ash, crude protein, as well as, fertility and hatchability (%)were decreased significantly (P< 0.05 and P<0.01) at storage period of eggs (7 d.) on temperature storage (26^{o}c) without covering as compared with other treatments, while yolk %, lose weight of eggs % and mortality rate of embryos at 11-18 or at 19-21d. of incubation. were increased significantly (P< 0.05 and P<0.01).

The results of the present study indicated that eggs from laying hens had significant deterioration of internal quality with increasing storage of eggs period and temperature.

The results suggest that egg weight lose%, egg quality and hatchability as influenced by the storage eggs of period & temperature level and covering system of eggs from hens.

Keywords: Storage period, storage temperature, covering system, egg quality, lose weight, hatchability.

INTRODUCTION

Environmental factors such as temperature, relative humidity, the presence of CO_2 and storage time are also of prime importance in terms of the maintenance of egg quality. Excess loss of water from the egg through evaporation at a rate that is influenced by the temperature and relative humidity during the Long-term storage conditions has generally been reported to be detrimental to table and hatching egg quality (Haugh, 1937, Ihekoronye and Ngoddy, 1985 and Jacob, 1998). Some researchers have reported a decline in hatchability by as much as 5% per day after 7d of storage (Kul and Seeker 2004). However, egg quality characteristics, utilization for food, storage and other purposes have been studied mostly in chicken egg. Egg quality is composed of those characteristics of an egg that affect its acceptability to consumers, it is therefore important that attention is paid to the problems of preservation and marketing of eggs to maintain the quality (Adeogun and Amole, 2004, and Song *et al*., 2000). Among many quality characteristics, external factors including cleanliness, freshness, egg weight and shell weight are important in consumer's acceptability of shell eggs. On the other hand, interior characteristics such as yolk index, Haugh unit, and chemical composition are, also important in egg product industry as the demand for liquid egg, frozen egg, egg powder and yolk oil increases (Scott and Silversides, 2001). Jin *et al*., (2011) showed that interaction effects between storage temperature and time were also significant in terms of egg weight loss, shell weight and percentage, albumen weight and percentage. Eggs deteriorate in internal quality with time and this is depending on the shell and internal content of the egg (Adeogun & Amole, 2004 and Kul & Seeker, 2004). Poor storage conditions may result in deterioration of egg quality and consequently lose and waste of eggs. There are reports which show that loss of water through pores, prevention of microorganism invasion and lower temperature are major considerations of retarding quality degradation. Since storage environment influence the quality of eggs, methods like lower temperature and modified atmosphere packaging such as refrigeration have been recommended (Chang and Chen, 2000).

A decrease in hatchability can be detected in eggs stored for 2–3 days or more. Storage temperature should be decreased with extended length of storage.

Temporary heating before incubation and enclosing eggs in plastic bags during storage improves hatchability, especially when storage is prolonged. A high humidity during storage also improves hatchability, probably due to a reduction in water loss (Meijerhof, 1992). Hurnic *et al*., (2010) reported that the highest Haugh unit groups had higher percent hatches ($P<0.01$) than the lowest groups. Becker *et al.*,(1963 & 1964), and Becker (1964) showed that storing fertile eggs of chickens, quail and turkeys in plastic bags improved their hatchability on subsequent incubation.

Therefore, the objective of this study was to evaluate the effects of some managerial factors (storage of temperature level and periods, as well as, covering system of eggs) on egg quality, chemical analysis of eggs, lose weight of eggs and hatchability, as well as, economical efficiency in laying Inshas hens at 42 weeks of age, under Egyptian environmental conditions.

MATERIALS AND METHODS

The experimental work of this study was carried out at Inshas Poultry Research Station, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt, during September 2010. A 3x3x2 factorial design experiment was performed including three levels of temperature storage (5^oC, 16^oC and 26^oC), three period of storage (1, 4 and 7 days) and two of covering system eggs (without and thick layer as using plastic layer).

A total number of 2052 eggs were daily collected from Inshas local strain at 42 weeks of age and stored in same three chambers. Eggs were randomly distributed into 18 treatment groups (114 eggs in each treatment groups). Each group was sub-divided into three replicates, each of 38 eggs. The temperature of 26^oC it is the temperature room during period of storage eggs but (5^oC or 16^oC) was determined by cooled and control thermostat. Eggs of all treatments stored individually of box in the rooms. Relative humidity was 55 to 60% for all treatment groups.

Egg quality:

Six eggs from each treatment group were taken to estimate egg quality measurements, each egg was weighed and broken and the height of albumen and yolk were measured within a tripod micrometer. The albumen and yolk were separated and only yolk and shell as well as weighed. The Haugh units were calculated from the HU formula [$HU = 100 \log (H + 7.57 - 1.7W^{0.37})$] where: H=Albumen high (mm), W= Egg weight (gm) according to Haugh (1937). Egg yolk width was measured by using a compass. The yolk indices were then

calculated as follows: Yolk index = Yolk height/ Yolk width x100. Yolk index were calculated according to Funk *et al.*, (1958).

Analytical methods:

A total of 54 eggs (3 eggs from each treatment group) to determined of moisture content was determined by drying in hot air oven at 100-102^{o}C for 16-18 hours, crude protein was estimated by multiplying 6.25 to nitrogen content obtained through Kjeldahl method, ether extract and ash were analyzed by soxhlet extraction and 550^{o}C muffle furnace, respectively according to AOAC (2003).

The weight lose percentage of eggs was calculated individually for each egg by the difference between initial weight and the weight of the end period of storage.

For preheating, eggs were placed in an incubator where the hot air was circulated and warmed gradually. These eggs were warmed from storage temperature up to room and then incubation temperature. This process of pre warming lasted for 6-7 hours before incubation eggs were transferred to the pre-heating room and grouped according to storage. Four turning, the eggs were stored with small end down and slanted at an angle of 40 to 45 degrees. They were placed on egg flats and one end of the flat was elevated to give the proper slant. In this way the eggs were turned by elevating alternate ends of the flat each day, for 6-8 times. After giving the above treatment during the holding period, these eggs were set in the incubator with broad end upward. The temperature of incubator was maintained at 37.6ºC with relative humidity of 70%. These eggs were turned at an angle of 45^{o} after every hour till 17 days of incubation. On day 17, each egg was candled for any infertile/clear egg/dead in shell. On 18th days, these eggs were shifted to the Hatcher, where temperature was adjusted at 35.6ºC and relative humidity at 80%. After 21 days, hatchability percentage was calculated.

Total number 1890 eggs of 105 from each treatment in three replicates (each of 35 eggs) were incubated. After hatching, chicks were counted; weighted chicks and non-hatched eggs were broken to determine the percentages of fertility, mortality of embryos at days of 11-18 and 19-21days of incubation and hatchability. While the hatchability was expressed as chicks hatched from total set eggs.

Economical efficiency:

The economical efficiency (EE) of the experimental treatments was estimated depending on price of hatched eggs and price chick produced from hatching.

Statically analyses:

Analysis of variance for data was used the SAS general Liner Model Procedure (SAS Institute, 2004). The effects of storage period, storage temperature

and covering of eggs were statically analyzed of variance as factorial design (3x3x2) according the following statically model:

$$Y_{ijkl} = u + P_i + T_j + C_k + PT_{ij} + PC_{ik} + TC_{jk} + PTC_{ijk} + e_{ijkl}$$

Where: Y_{ijkl} =An observation, μ = Overall mean, P_i = Effect of storage period (i = 1 …3), T_j = Effect of storage temperature (j = 1… 3), C_k = Effect of covering system of eggs (k =1 and 2), PT_{ij} = Interaction effect between storage period and storage temperature($_{ij}$ = 1,2, …..9) , PC_{ik} = Interaction effect between storage period and covering system (ik= 1,2 ……6), TC_{jk} = Interaction effect between storage temperature and covering system (jk= 1, 2 ……6) ,PTC_{ijk} = Interaction effect between storage period, storage temperature and covering system of eggs (ijk= 1, 2, ……18) and e_{ijkl} = Random error.

Means in the present study were tested for significant differences by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSIONS:

1. Egg quality traits:

Results in Table 1 indicated the effect of storage period, temperature level and covering system on egg quality traits. Storage period significantly affected (P<0.05 and P<0.01) almost of egg quality all parameters investigated in the present study. Albumen weight %, Shell weight% and HU were decreased significantly (P<0.05 and P<0.01), while yolk weight % increased significantly (P<0.01) by increasing storage periods of eggs. Yolk index was not significant by storage periods. Concomitant decreases in weight of albumen and yolk were also observed with increased storage eggs of periods and temperature level. Yolk index and HU decreased with increase period of storage. This was due to breakdown of the fibrous glycoprotein ovomucin. Haugh (1937) indicated that egg yolk size increased with storage period due to movement of water from the albumen to the yolk as a result of osmotic pressure differences. These results are in agreement with those of Silversides and Scott (2001), they reported that measuring components of eggs as proportions of the whole egg removed any inconsistencies, and longer periods of storage resulted in greater shell % and yolk % and a lesser albumen %. This result disagreement with Akyurek and Okur (2009) they reported that albumen and yolk weights did not change within 10 days of storage at any temperature level.

Also, albumen%, HU and yolk index were significantly (P<0.05 and P<0.01) decreased, yolk % was significantly (P<0.01) increased by increasing storage temperature level of eggs. These results are in agreement with those of

Silversides and Scott (2001), they reported that albumen weight decreased and yolk weight increased with storage temperature and time.

However, egg quality traits were insignificantly affected by covering system of eggs at storage.

Interaction between stored period and temperature level were significant ($P<0.05$ and $P<0.01$) influenced egg quality. Eggs stored at 26^{o}C temperature and at 7 days were decreased significantly ($P<0.05$ and $P<0.01$) for albumen %, HU and yolk index as compared with other treatments. These results are in agreement with Samli *et al.*, (2005) who reported that storage time and temperature adversely affected HU ($P<0.01$). Similar results were demonstrated by other researchers (Tona *et al.*, 2004; Akyurek and Okur, 2009).

Interaction between stored period and covering system of eggs were decreased significantly ($P<0.01$) albumen weight % and HU, while yolk weight % was increased significantly ($P<0.01$) by storage at 4 or 7 days without covering layer system as compared with plastic layer system at one day of storage.

Interaction between temperature level and covering system were influenced significantly ($P< 0.05$) on HU and yolk index.

Results in Table 2 showed that interaction between stored period, temperature level and covering system were significant ($P<0.05$ and $P<0.01$) influenced egg quality traits. Percentage of albumen and HU were significantly ($P<0.05$ and $P<0.01$) decreased at storage 7 days and temperature level 26^{o}C without covering as compared with other treatments, while yolk % was significantly ($P<0.01$) increased. However, shell and yolk index were not significant by storage methods.

2. Chemical analyses of eggs:

Data in Table 3 indicated that the chemical analyses component of eggs (moisture %, ether extract %, ash % and crude protein % content) were decreased significantly ($P<0.01$) with increasing stored periods.

Also, chemical analyses component of (moisture, ether extract and ash) of eggs were decreased significantly ($P<0.01$) with increasing temperature level of storage.

However, chemical analyses component of eggs (moister and ash %) were increased significantly ($P<0.05$) with covering system using plastic bags compared with without group. While, ether extract % and crude protein content % of eggs did not significantly affect with covering system.

Table 3: Chemical composition of eggs $\left(\overline{X} \pm SE\right)$ of Inshas layers as affected by storied periods, temperature levels and covering system at 42 weeks of age

Items	Moisture %	Ether extract %	Ash %	Crude protein %
Effect of storage period (P):				
1 day	14.05±0.32[a]	25.75±0.39[a]	3.23±0.13[a]	33.49±0.24[a]
4 days	13.11±0.25[b]	24.40±0.35[b]	3.09±0.15[a]	33.10±0.21[a]
7 days	11.93±0.29[c]	23.27±0.29[c]	2.73±0.12[b]	31.96±0.20[b]
Significance	**	**	**	**
Effect of temperature levels (T):				
5 ^{0}C	14.06±0.29[a]	25.51±0.36[a]	3.30±0.13[a]	33.26±0.23
16 ^{0}C	12.61±0.32[b]	24.18±0.40[b]	2.97±0.15[b]	32.84±0.30
26 ^{0}C	12.42±0.31[b]	23.73±0.39[b]	2.77±0.10[b]	32.46±0.23
Significance	**	**	**	**NS**
Effect of cover system (C):				
Without	12.73±0.33	24.41±0.39	2.83±0.12	32.77±0.24
Plastic layer	13.33±0.26	24.54±0.33	3.20±0.11	32.93±0.22
Significance	*	**NS**	*	**NS**
PxT	**	**	*	**
PxC	**	**	**	**
TxC	**	*	*	**NS**

Means having different letters at the same column in each classification are differ significantly(P<0.05).

* = (P<0.05), ** = (P<0.01); NS= Not significant.

Results of the present study showed that the chemical analyses component of eggs (moisture %, ether extract, ash % and crude protein %) after stored treatments were decreased significantly (P<0.05 and P<0.01) for eggs storage 7 days and temperature level 26^{o}C as compared with other treatments (Table 4).

Interaction between stored period and covering system of eggs were significantly (P<0.01) influenced on percentage chemical composition of eggs.

Interaction between temperature level and covering system were significantly (P<0.05 and P<0.01) affected influenced on chemical analyses component of eggs for moisture %, ether extract % and ash %. Refrigeration and covering thick layer of eggs had the highest values for moisture, ether extract, ash and crude protein content as compared with without cover. These results are in agreement with Dudusola (2009) who found that decrease in the

values of the moisture, ether extract, ash and crude protein content of egg quality during storage period.

The results tabulated in Table 4 shows that, the interaction between storage periods, temperature level and covering system were influenced significantly ($P<0.05$ and $P<0.01$) on almost percentages of chemical composition of eggs stored to 7 days at 26^{o}C without covering system.

3*. Fertility and hatchability:*

Table 5 showed that the percentages of lose weight of eggs, embryo mortality at 11-18 days and at 19– 21 days of incubation were increased significantly ($P<0.05$ and $P<0.01$) while, fertility and hatchability were significantly ($P<0.01$) decrease when increase of storage period at seven days as compared with storage at one or four days. These findings are in agreement with results reported by Ekine and Ajuogu (2011) who found that the egg storage for more than four days should only be used under special circumstances, as long storage times reduce hatchability due to increased embryo mortality. Schmidt *et al.,* (2009) show a significant effect of storage time on hatchability and embryo mortality. Hatchability started to be reduced on four days of storage, with losses of 1.38 % per day up to day 4 of storage. Similar results were obtained by Decuypere and Micheles (1992), who found that for each 1 day in storage time, hatchability was reduced in 1.0 % and added 1.hour in incubation time.

An increasing of temperature at 16^{o}C and 26^{o}C were increased significantly ($P<0.01$) lose weight % and mortality rate at 19 –21 days of incubation eggs while, fertility and hatchability were significantly ($P<0.01$) decreased as compared with temperature level in 5^{o}C. These findings are in agreement with results reported by Ekine and Ajuogu (2011) showed that higher storage temperatures (27-30^{o}C) favored early embryonic deaths as compared to lower pre-incubation storage temperatures (8-19^{o}C). Ruiz and Lunam (2002) they reported that storage at 16.5°C compared with 10°C decreased both hatchability of fertile eggs and chick weight at hatch. Incidence of early embryonic death increased and incubation time decreased at 16.5°C compared with 10°C.

Plastic layer covered of eggs were significantly ($P<0.05$and $P<0.01$) improved lose weight % mortality of embryos at 11-18 days and at 19 – 21 days of incubation, fertility and hatchability % as compared with without covering. However, hatch weight was not significant at all parameter studies. Reijrink (2009) reported that storing the eggs in plastic bags to avoid loss of carbon dioxide. Research has already shown that storing eggs in plastic bags

can improve hatchability after prolonged storage. Proudfoot (1964a) confirmed that the hatchability of stored eggs was improved when the eggs were sealed in plastic film.

Interaction between stored periods and temperature storage showed that the eggs stored at 7 days with temperature level in 16 or 26^{o}C were increased significantly ($P<0.05$ and $P<0.01$) of lose weight % and late mortality % of embryos, while fertility and hatchability were decreased significantly ($P<0.01$) as compared with other treatments. These results in agreement with Jin *et al*., (2011) showed that interaction effects between storage temperature and period were also significant in terms of egg weight loss, shell weight and percentage, albumen weight and percentage. Moreover, these findings are in-agreement with results reported by Ekine and Ajuogu (2011) who reported that storage time and temperature adversely affected on fertility and hatchability.

Interaction between stored periods and covering system were significantly ($P<0.05$ and $P<0.01$) influenced on lose weight %, late mortality %, fertility and hatchability. Eggs stored on four and seven days with covered by plastic layer caused to reduce percentages of lose of egg weight and late embryonic mortality, while fertility and hatchability increased as compared with or without covering system.

Interaction between stored periods, temperature storage and covering system were influenced significantly ($P<0.05$ and $P<0.01$) for percentages of lose weight and mortality of embryos at 11-18 days and at 19 – 21 days eggs, fertility and hatchability. Eggs in stored at 7 days under temperature level in 16 or 26^{o}C without covering system were increased significantly ($P<0.05$ and $P<0.01$) percentage of lose weight, mortality of embryos at 11-18 days and at 19 – 21 days of incubation, while fertility and hatchability were decreased significantly ($P<0.01$) as compared with other treatments (Table 6).

4. Economic efficiency (EE %):

Data presented in Table 7 indicated that eggs of Inshas hens stored at 1, 4 or 7 days under temperature (5^{o}C, 16^{0}C and 26^{o}C) and covering of eggs (by thick layer or without), the best economic efficiency (EE%) value was found to produce number of chick in treatment stored at one day, while temperature level in 26^{o}C caused to decrease percentage of (EE%). However, covering of the eggs by plastic layer results of increased (EE %) compared with without covering.

Data in Table 8 show that the interaction between stored time, temperature level and covering system of eggs showed that economic efficiency (EE %) were reduced at stored eggs of period 7 days under

temperature level in 26°C at without covering system. The best EE value and increase of hatchability to produce number of chicks were obtained with stored (decrease of periods and temperature levels) and covering of eggs by plastic layer as compared with other groups (Table 8).

In conclusion, from some management factors of eggs at pre-hatching and physiological points of view, it could be concluded that the use of reduce temperature levels or covering by plastic layer improved the egg quality traits, hatchability (%) and economic efficiency (%) of local strain Inshas hens, under Egyptian environmental conditions.

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تأثير بعض العوامل الرعائية على جودة البيض والتحليل الكيماوى وعملية التفريخ لسلالة الدجاج ألبياض المحلي.

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صممت تجربة عامليه ٣ × ٣ × ٢ لدارسة تأثير ثلاث عوامل رعائية هي ثلاث فترات من مدة تخزين البيض (١ او٤ أو ٧ أيام) وثلاث مستويات من درجات الحرارة (٥ أو ١٦ أو ٢٦ درجة مئوية) مع وضع البيض تحت غطاء بلاستيك أو بدون غطاء على صفات البيض لسلاله دجاج إنشاص البياض عند عمر ٤٢ أسبوع. استخدم عدد ٢٠٥٢ بيضة قسمت عشوائيا إلى ١٨ مجموعة (١١٧ بيضة / مجموعة) وقسمت كل مجموعة إلى ثلاث مكررات في كل منها ٣٨ بيضة. وتم دراسة الأداء التناسلي وصفات البيض.

وأوضحت النتائج ما يلي:

- أظهرت النتائج التي تم الحصول عليها أن زيادة فترة التخزين وارتفاع درجات الحرارة تسبب معنويا ($P<0.05$ و $P<0.01$) في انخفاض كل من الالبيومين ٪، وحدات Haugh (HU)، دليل الصفار، والرطوبة، مستخلص الأثير، الرماد، البروتين الخام، والخصوبة ونسبة الفقس، في حين زادت معنويا ($P<0.05$ و $P<0.01$) النسبة المئوية لكل من الصفار والفقد في وزن البيض، ومعدل نفوق الأجنة عند فترات ١١-١٨ و ١٩-٢١ يوم من التفريخ للبيض المخزن لمدة ٧ أيام أو عند ٢٦°م والبيض المغطى بالبلاستيك أفضل من غير المغطى.
- أوضح التداخل بين فترات تخزين، درجة الحرارة التخزين ونظام تغطية البيض انخفاض كل من الالبيومين ٪ ، قشرة البيض ٪، HU، دليل الصفار ، التحليل الكيماوى للبيض (الرطوبة، مستخلص الأثير، الرماد، البروتين الخام) ونسبة الفقس وانخفضت بشكل معنوى ($P<0.05$ و $P<0.01$) عند تخزين البيض لمدة ٧ أيام على درجة حرارة ٢٦°م بدون تغطية مقارنة مع المعاملات الأخرى، في حين أن الصفار٪، والفقد النسبي لوزن البيض ومعدل نفوق الأجنة في ١١-١٨ أو ١٩-٢١ يوم من التفريخ زادت معنويا (($P<0.05$ و $P<0.01$).

الخلاصة: نستخلص من هذه الدراسة انه يجب ان يخزن بيض التفريخ تحت درجة حرارة منخفضة او بتغطيتة بالبلاستيك لتلافى الفقد الزائد فى الرطوبة الداخلية للبيض والمحافظة على المكونات الداخلية والحلة الفسيولوجية لبيض التفريخ تحت الظروف المصرية.