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RELATIONSHIP BETWEEN EGG SHELL, EGGSHELL MEMBRANES AND EMBRYONIC DEVELOPMENT THROUGH DIFFERENT EGG PRODUCTION PERIODS IN TWO DEVELOPED CHICKEN STRAINS

By

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Abstract:- *Thirty males and 300 laying hens from Bandarah and Baheij chicken strains at 32 weeks(8 months) of age were used in this study to assess the contribution of eggshell membranes beside eggshell thickness at various flock ages during laying cycle on egg weight loss ,embryonic mortality during incubation and hatchability process. Experiment was conducted utilizing 6000 hatching eggs at EL-Sabahia Poultry Research Station, Animal Production Research Institute. Two hatches were used monthly through ten months from 8 to 17- month of the bird's age. In addition to, three hundred eggs from each of chicken strain were used for eggshell measurements, and represented the same ten months of experimental ages.*

The results indicated that the same trend of decreasing eggshell thickness with advancing of flock age and laying cycle was observed with eggshell membranes thickness. Eggshell and eggshell membranes were thicker for Baheij chicken strains than those for Bandarah strain. Moreover, egg weight loss during the accumulated stage of setting incubation period (0 – 18 days) seemed to be greater significantly ($P \leq 0.05$) throughout the late months of laying cycle and age for both the experimented strains compared to that produced at the early and middle months of egg production cycle.

Also, eggs from younger birds represented significantly ($P \leq 0.05$) higher percentages of macroscopic fertility and hatchability compared to those from older layers at last months of laying (16 and 17^{th} months old of age) as these parameters were dropped dramatically. Baheij strain had surpassed significantly ($P \leq 0.05$) Bandarah strain with respect to macroscopic fertility, hatchability of fertile and total eggs. These differences between chicken strains could be due to the eggshell membranes and eggshell thickness which affect egg weight loss and resulted in hatchability *percentage. As the hen ages during the laying cycle, embryonic mortality percentages during incubation had increased from 7.89% and 5.06% on 8th month of age to 16.73% and 17.55% on 17th month of flock age for Baheij and Bandarah strains, respectively. It could be concluded that parental age had a marked effect on embryonic mortality and it increased with the increase of flock age.*

Results show highly significant ($P \leq 0.01$) correlation between eggshell membranes and eggshell thickness for Bandarah (0.464) and Baheij (0.558) chicken strains. Also, these results of phenotypic correlation among studied traits indicated that thickness of shell membranes and eggshell had an important role and could affect embryonic mortality and hatchability.

INTRODUCTION

The success of embryonic development has been related to eggshell and shell membrane characteristics (Narushin and Romanov, 2002). The greatest portion of avian eggshell consists of crystalline calcium carbonate layer and the pores penetrates this layer to permit diffusion gases (Burley and Vadehra, 1989). Thicker shells produce great resistance to gaseous diffusion (Rahn et al., 1979). Young hens produce eggs with thicker shell than older hens (Britton, 1977; Peebles and Brake, 1987). Eggshell and hatchability of broiler breeder eggs are different between ages (McDaniel et al., 1979). Peebles and Brake (1987) mentioned that maximum hatchability is often observed during the middle of laying period and it related to shell thickness.

Inside the eggshell proper are two shell membranes , inner and outer, which are of different thickness and in close contact except at the broad end. The shell membranes consist of a mixture of protein and glycoprotein (Burley and Vadehra , 1989). The membranes exhibit some types of aeration during early incubation when air displace the water that evaporate from the space between the membranes and appears to be aided by some interactions between the membranes and albumen (Seymour and Piiper, 1988). The aeration must occur because the permeability of fresh eggs to oxygen is not sufficient for all stages of incubation (Kayar et al., 1981). The permeation of air through the eggshell and shell membranes affect the hatchability (Tullett and Deeming, 1982 ; Peebles and Brake, 1987). Whereas, Soliman et al. (1994) reported that until yet there is undefined role of shell membrane function in incubation. Britton (1977) found that the shell membranes from young hens are thicker than those of older ones. This support the works of Balch and Tyler (1964) and Britton (1976) who found that aged hens have thinner membranes.

In order to hatch, an egg must lose 12- 15 % of its weight primarily as water during incubation to maintain proper vital gas exchange (Rahn et al., 1979 ; Tazawa , 1980). Egg weight loss has been used to estimate vital gas exchange (Rahn et al., 1979) and has been correlated with the rate of embryonic metabolism and development (Rahn and Ar, 1980 ; Burton and Tullett, 1983). The major rate of resistance to gas exchange has been attributed to the egg shell with lesser contribution from the shell membranes (Tullett, 1978; Rahn et al., 1979). Shebl and Soliman (1999) mentioned that egg shell and shell membranes thickness may affect egg weight loss and hatchability. The embryonic mortality increased in eggs of older laying hens compared to younger one (Novo et al ., 1997 ; Sahan and Ipek, 2000) . Peebles et al. (2001) and Tona et al. (2001) reported that age of the parent flocks influences subsequent fertility. Also, different authors reported that age had a significant ($P \leq 0.05$) effect on hatchability traits (Woodard et al ..1976; Peebles et al., 2000 and EL-Attar and Fathi , 2002).

The purpose of this study was to assess the contribution of the thickness for eggshell membranes and eggshell on egg weight loss during incubation, embryonic mortality and hatchability at various flock ages during laying cycle in two developed chicken strains.

MATERIALS AND METHODS

The study was conducted at EL-Sabahia Poultry Research Station, Animal Production Research Institute, Agricultural Research Center through the years 2005 and 2006 . Thirty males and 300 laying hens from Bandarah and Baheij strains at 32 weeks (8 months) of age were used. Birds were housed in floor pens under the same managerial procedures throughout the experimental periods. Experiments were conducted utilizing 6000 hatching eggs. Two batches of hatching eggs were represented monthly through ten months from 8 to 17 months of the bird's age . Besides, three hundreds eggs after laying from each chicken strain were used for eggshell measurements through a laying cycle representing the same ten months of the studied flock ages. The shell with its membranes were weighed to the nearest 0.1gm. Three pieces of eggshell thickness at the egg equator were measured to 0.01mm accuracy with a micrometer. The equator region was chosen because variability in shell thickness was found to be least at the equator (Romanoff and Romanoff ,1949). Shell thickness was measured with and without the membranes after drying for 24 hours at room temperature. Membranes were removed by boiling the eggshell in 5% NaoH for 10 minutes. Membrane thickness was calculated by the difference in shell thickness with and without the membranes.

The eggs were incubated in forced draft type incubator (Egyptian. made) at 99.5°F temperature and 55% relative humidity in the setter and kept in the hatcher under 98.6°F temperature and 65% relative humidity. Eggs were consequently numbered and weighed to the nearest 0.1gm by using an electronic balance before setting in the incubator. Egg trays were randomly distributed in the incubator. Reweighing of the same eggs was done again on the 5^{th} ,10^{th} ,15^{th} and 18^{th} days of incubation in order to obtain egg weight loss percentages. The percentages of egg weight loss for each incubation interval and each chicken strain were calculated by differences of egg weights and expressed as a percentage of initial egg weight . On the 18^{th} day of incubation all eggs were transferred into separate hatcher and testing for infertility was done. The infertile clear eggs were macroscopically evaluated to determine apparent infertility by naked eyes. Macroscopic fertility was calculated as the percentage of fertile eggs from total setting eggs. Hatchability was calculated as the percentage of sound hatched chicks from either setting or fertile egg and averaged monthly for each strain. At the end of incubation period, all eggs that failed to hatch were broken out and examined to record the total embryonic mortality.

Statistical analysis:-

Phenotypic correlation coefficients between the different characteristics for both Bandarah and Baheij strains were estimated according to procedure CORR in SAS program, (1996). Also, statistical analysis was performed using SAS program to estimate the relation between eggshell membrane and eggshell thickness as well as hatchability characteristics at different age months throughout laying cycle. Significant differences between treatments were done according to Duncan's New Multiple Range Test (Duncan, 1955).

The fixed model was :-

$Yijk = \mu + Ai + Bj + Eijk$

Where:-

$Yijk$ = the dependent variable , μ = the overall mean , Ai = Age effect,

Bj = Strain effect , and $Eijk$ = remainder

RESULTS AND DISCUSSIONS

Table 1 shows that both eggshell and shell membranes thickness in Baheij and Bandarah strains had significantly ($P \leq 0.05$) decreased through advanced flock age .Shell thickness on 32 weeks (8^{th} month) of parent age for Baheij and Bandarah strains were 0.378 and 0.368 mm , respectively and 0.296 and 0.289mm on 68 weeks (17^{th} month) of parental age, respectively.

Moreover, the corresponding values for shell membranes thickness were 0.040 and 0.035mm on 32 weeks of age (8th month) and 0.020 and 0.019mm on 68 weeks (17th month) , respectively.

The results revealed that the same trend of decreasing eggshell thickness with advancing of flock age and laying cycle was observed with eggshell membranes thickness. Generally eggshell and eggshell membranes thickness for eggs produced in the first months of hen's age were thicker than those in the advanced months of age . Some workers have asserted the same conclusion (Britton ,1977 ; Peebles and Brake, 1987 and El-Labban, 2000). Also, Britton and Hale (1977) mentioned that the shell of an egg begins with the formation of the shell membranes upon which the true shell is deposited in crystalline form and the amount of shell membranes in an egg is related to the shell quality and age of the hen which laid the egg. Moreover, data in Table 1 reveal that there were significant differences ($P \leq 0.05$) between Baheij and Bandarah strains in eggshell and eggshell membranes thickness. Eggshell thickness for Baheij strain (0.354mm) was thicker significantly ($P \leq 0.05$) than those for Bandarah strain (0.328mm) . The same trend was observed in shell membrane thickness as Baheij strain (0.031mm) was thicker significantly ($P \leq 0.05$) than that for Bandarah strain (0.027mm). These results are in accordance with those obtained by Ali et al. (1998) and El-Labban (2000). Moreover, the data substantiate the works of Shebl and Soliman (1999) who showed significant differences ($P \leq 0.05$) among chicken strains in egg shell and shell membranes thickness.

Generally, egg weight loss for Baheij and Bandarah strains during all studied intervals was changed and increased over time through the laying periods from 8th to 17th months of age (Table 2). Egg weight loss during the accumulated stage of setting incubation period (0 – 18 days) seemed to be greater significantly ($P \leq 0.05$) throughout the late months of laying cycle and age for both the experimented strains compared to that produced at the early and middle months of flock age. Information obtained from this experiment indicated that the mechanism of egg weight loss during incubation could be due to the interaction of changes in shell and shell membranes with flock age. which resulted in excessive moisture loss during the late stage of laying cycle and flock age .Data and conclusions reported herein added credence to reported observation by Rahn et al. (1979) who mentioned that the physical characteristics of eggshell and shell membranes have been characterized as barriers to gas exchange . The physical nature of these various egg components which change with the age of the hen may alter the magnitude of their influence on the overall resistance to diffusion . If the permeability is very low then additional problems of oxygen supply or carbon dioxide removal can complicate the survival of the embryos (Tullett and Deeming , 1982). Also, Deeming (1989) demonstrated that insufficient water loss result in poorly developed air cell, poor gas exchange , wet embryos and many of which die near point of hatch or soon after. Moreover he reported that excessive water loss resulted in reduced hatchability causing dehydration of embryos and prevent hatching. A small role has been attributed to the shell membrane as barrier to gases diffusion (Tullett, 1978 and Rahn et al., 1979). The same functional component of the egg such as shell membrane may contributes in excessive weight loss as suggested by Soliman et al. (1994). Peebles and McDaniel (2004) recognized that vital gas exchange and the metabolism of embryo and chicks from young hens is compromised. Moreover, results in Table 2 showed that egg weight loss during the all studied intervals of incubation for Bandarah strain was significantly (P $\leq$0.05) greater than that from Baheij strain. These significant differences in egg weight loss during incubation between chicken strains could be attributed to the differences in eggshell and shell membrane thickness. These results are in accordance with those obtained by EL-Turkey et al. (1981) and Shebl and Soliman (1999).

In conclusion , eggshell membranes and eggshell thickness act as a barriers to water vapor diffusion or act to enhance water vapor diffusion and those properties had been affected by the age of the bird.

It can be seen from Table 3 that macroscopic fertility percentage, hatchability of fertile eggs and total eggs percentages were significantly (P$\leq$ 0.05) higher in the first months of laying compared to those at the late months of laying cycle . Besides , this table reveals that the first five months of laying were characterized with an increase of macroscopic fertility and hatchability percentages . Whereas, the last three months of laying (15,16 and 17th month of age) had lower values for the same traits for Baheij and Bandarah strains. It means that previous mentioned parameters of fertility and hatchability significantly (P $\leq$ 0.05) declined as the hens aged . Eggs from younger birds represented significant (P $\leq$ 0.05) higher percentages of macroscopic fertility and hatchability compared to those from older layer in the last two months of laying (16 and 17th months of age) as these parameters were dropped dramatically. Data of fertility which appear in the results refer to the macroscopic fertility and not real fertility, it means that data of the recorded fertility may include the early dead embryos which died on the first 12 hours of incubation and could not diagnose by naked eye . North and Bell (1990) have drawn the same conclusion and interpretation, who showed that hatchability drops as breeder age. Their eggs became much larger and are held in the oviduct longer, thereby increasing the length of the preovipositai incubation period. To add to this difficulty , the eggshell of older hens is always thinner. These large eggs laid by the older hens show a higher incidence of embryonic death at the time they are placed in the incubator when embryonic growth is reinitiated . These deaths come so early that they are often not noticed and are usually classified as infertile.

Therefore, it is normal that fertility macroscopic and hatchability could be affected by eggshell and shell membranes thickness . Results herein are in agreement with finding of Seker et al. (2004) who found that the fertility was decreased with older group. Similar findings were obtained by Erensayin (2002) and EL-Sheikh (2007). A number of authors came to another conclusion that fertility had not been affected significantly by age of males and females (Hocking and Bernard, 2000 and shahein et al., 2007). Moreover, Tsarenko (1988) found that the hatchability of thick-shelled eggs was higher than those with thin-shell. An increase in shell thickness of one micrometer in the range of 0.29 --- 0.35mm led to an increase in hatchability of about 2% (Sergyva, 1986). Koneva (1968) found that the contribution of shell and shell membranes thickness of turkey eggs to their hatchability was around 40%. Whereas, Burton and Tullett (1983) and Christensen (1983) observed that optimum hatchability has been reported to depend upon a proper relationship between pore concentration and shell thickness which provide the proper water loss for optimum embryonic growth .

It was postulated from the results of hatchability that eggshell membranes and egg shell thickness may contribute to the dynamic change over a production cycle and would further implicate the shell membranes as a determinant of shell quality .

Significant differences were apparent in macroscopic fertility and hatchability percentages between chicken strains (Table 3). Baheij strain had significantly ($P \leq 0.05$) surpassed Bandarah strain with respect to macroscopic fertility, hatchability of fertile and total eggs. These differences between chicken strains could be due to the differences in their eggshell membranes and eggshell thickness which affect the egg weight loss and resulted in hatchability percentage. Different authors came to the same conclusion herein that there were significant differences between local breeds with respect to fertility and hatchability (Abdel Galil , 2004 and Ensaf et al .,2005).

As the hen ages during the laying cycle ,the embryonic mortality percentages during incubation had increased from 7.89 % and 5.06% on 8th month of age to 16.73% and 17.55% on 17th month of flock age for Baheij and Bandarah chicken strains , respectively (Fig1). It could be concluded from this figure that parental age had a marked effect on embryonic mortality and it increased with the increase of flock age. Also, this figure illustrates that a little increase in embryonic death percentage was observed between the experimented chicken strains. Eggs from Bandarah chicken strain represent a slightly higher embryonic death percentage compared to those eggs from Baheij chicken strain except on the 8^{th} day of incubation. These differences in embryonic mortality percentages between flock ages and chicken strains could be explained by the differences in eggshell membranes with eggshell thickness. These results are in harmony with different authors who reported that rate of egg weight loss during incubation might be related to embryonic mortality or development (EL-Turkey et al., 1981; Peebles and Marks, 1991 and Shebl et al ., 1996). Moreover, Novo et al. (1997) mentioned that embryonic mortality increased in eggs of older laying hens compared to young ones. Similarly, Sahan and Ipek (2000) reported that the parental age had affected embryonic mortality and this rate was excessive in hens with 66 weeks age. On the other hand some research workers came to the contradictory results. Kurova (1986) presented data indicating that eggs with extremely thick or thin shells resulted in increase embryonic mortality when compared to embryonic mortality from eggs of an average thickness. Besides, Narushin and Romanov (2002) reported that fertile eggs have the highest probability of hatching success when their physical characteristics are average . If this is not the case, the results of incubation can be questionable.

The phenotypic estimates of relationship among studied traits for Bandarah and Baheij chicken strains are presented in Table 4. The same trend of correlation between shell membranes thickness and other studied traits was observed for shell thickness for both chicken strains. Highly significant ($P \leq 0.01$) correlation between shell membrane and shell thickness was noticed for Bandarah (0.464) and Baheij (0.558) chicken strains. Also, highly significant ($P \leq 0.01$) relationship between shell membranes thickness was found with each of fertility (0.653) , hatchability of fertile eggs (0.614) and hatchability of total eggs (0.685) for Bandarah chicken strain. Whereas , negative significant correlations were found between shell membrane thickness with egg weight (- 0.198) and shell weight (- 0.352) for the same chicken strain. Moreover, eggshell thickness of Bandarah strain had highly significant ($P \leq 0.01$) positive correlation with fertility (0.653) , hatchability of fertile eggs (0.614) and hatchability of total eggs (0.685) , while it has not any significant relationship with egg weight loss (- 0.074) during the setting incubation period. Generally the same trend of correlation was observed for Baheij chicken strain with little exceptions, as shell membranes and egg shell thickness are significantly correlated with egg weight loss during incubation.

The results of phenotypic correlations herein indicate that shell membranes thickness had an important role with eggshell thickness and could affect embryonic mortality or development and hatchability of chicken eggs. These results are in accordance with those obtained by Shebl and Soliman (1999).

Upon the obtained results of the present study , it could be concluded that eggshell membranes and eggshell thickness act as barriers to egg weight loss during the early stage of laying cycle. Also, the decrease of eggshell membranes and eggshell thickness with the increase of flock age could diminish the percentages of hatchability of fertile and total eggs. In addition, the parental age had a marked effect on embryonic mortality which had increased with the increase of flock age.

Tabl (1): Shell and shell membrane thickness (mm) as affected by flock age for Baheij (BG) and Bandarah (BN) chicken eggs

Traits / Age (month)	Shell thickness		Shell membranes thickness	
	BG	BN	BG	BN
	$\bar{X}$ ±S.E	$\bar{X}$ ±S.E	$\bar{X}$ ±S.E	$\bar{X}$ ±S.E
8	$0.378±0.003^{a}$	$0.368±0.004^{a}$	$0.040±0.004^{a}$	$0.035±0.001^{a}$
9	$0.375±0.003^{ab}$	$0.360±0.004^{a}$	$0.036±0.002^{ab}$	$0.030±0.001^{ab}$
10	$0.362±0.003^{c}$	$0.334±0.004^{b}$	$0.033±0.002^{bc}$	$0.030±0.001^{ab}$
11	$0.361±0.003^{c}$	$0.328±0.004^{bc}$	$0.032±0.004^{bc}$	$0.030±0.002^{ab}$
12	$0.365±0.003^{bc}$	$0.328±0.004^{bc}$	$0.032±0.001^{bc}$	$0.030±0.002^{ab}$
13	$0.365±0.004^{bc}$	$0.317±0.005^{cd}$	$0.032±0.001^{bc}$	$0.027±0.002^{bc}$
14	$0.345±0.004^{d}$	$0.313±0.004^{de}$	$0.029±0.001^{cd}$	$0.024±0.002^{cd}$
15	$0.329±0.004^{e}$	$0.308±0.005^{de}$	$0.026±0.002^{d}$	$0.022±0.002^{d}$
16	$0.321±0.005^{e}$	$0.300±0.003^{ef}$	$0.024±0.003^{de}$	$0.020±0.002^{d}$
17	$0.296±0.005^{f}$	$0.289±0.004^{f}$	$0.020±0.003^{e}$	$0.019±0.002^{d}$
Overall mean	$0.354±0.002^{A}$	$0.328±0.002^{B}$	$0.031±0.006^{A}$	$0.027±0.006^{B}$

a,b,c,d,e and f Means within each column for each item with different superscripts are significantly different ($P \leq 0.05$)

A and B Overall means of chicken strains under each item with different superscripts are significantly different ($P \leq 0.05$)

Table (2): Egg weight loss percentage for Baheij (BG) and Bandarah (BN) chicken strains during various incubation intervals as affected by flock age

Intervals / Age (month)			Egg weight loss %									
	Initial egg weight $\overline{X}$ ±S.E		0 -----5 day $\overline{X}$ ±S.E		5 ---- 10day $\overline{X}$ ±S.E		10 --- 15 day $\overline{X}$ ±S.E		15 --- 18 day $\overline{X}$ ±S.E		0 ---- 18 day $\overline{X}$ ±S.E	
	BG	BN	BG	BN	BG	BN	BG	BN	BG	BN	BG	BN
8	48.75± 0.57^{d}	50.86± 0.64^{b}	2. 16± 0.38^{c}	2.34± 0.17^{b}	1.o9± 0.19^{b}	2.49± 0.0.02^{b}	2.37± 0.15^{b}	2.98± 0.21^{bc}	0.56± 0.18^{c}	1.67± 0.22^{d}	7.22± 0.61^{bc}	9.71± 0.38^{c}
9	49.38± 0.38^{d}	50.90± 0.75^{b}	2.23± 0.09^{bc}	2.54± 0.10^{b}	1.69± 0.19^{b}	2.46± 1.03^{b}	2.36± 0.20^{b}	2.77± 0.59^{bc}	0.57± 0.18^{c}	1.89± 0.14^{d}	7.44± 0.72^{bc}	9.77± 0.60^{c}
10	49.56± 0.39^{d}	51.53± 0.58^{b}	2.32± 0.76b^{c}	2.75± 0.11^{ab}	2.37± 0.53^{ab}	3.17± 0.17^{a}	2.66± 0.38^{b}	2.69± 0.26^{bc}	1.11± 0.21^{c}	1.04± 0.28^{cd}	8.50± 0.56^{b}	9.80± 0.84^{c}
11	49.36± 0.48^{d}	52.06± 0.81^{b}	2.60± 0.54^{b}	2.79± 0.31^{ab}	2.89± 0.19^{ab}	3.28± 0.21^{a}	2.73± 0.37^{b}	3.06± 0.26^{ab}	1.36± 0.29^{bc}	1.36± 0.22^{bcd}	9.54± 0.35^{b}	10.47± 0.24^{b}
12	50.13± 0.54^{dc}	52.21± 0.23^{b}	2.29± 0.56^{bc}	3.00± 0.37^{ab}	2.89± 0.19^{ab}	3.38± 0.37^{a}	3.04± 0.07^{a}	3.06± 0.26^{ab}	1.50± 0.19^{bc}	2.36± 0.22^{bc}	9.82± 0.72^{b}	11.78± 1.88^{ab}
13	51.03± 0.26^{bcd}	52.98± 0.95^{ab}	3.60± 0.85^{a}	3.04± 0.68^{ab}	2.89± 0.18^{ab}	3.38± 0.37^{a}	3.03± 0.28^{a}	3.06± 0.26^{ab}	1.53± 0.20^{bc}	2.51± 0.19^{bc}	11.06± 0.59^{ab}	11.97± 1.76^{ab}
14	52.63± 0.55ab^{c}	53.37± 0.14^{ab}	3.18± 0.22^{a}	3.46± 1.72^{a}	3.03± 0.04^{a}	3.28± 0.21^{a}	3.20± 0.28^{a}	3.53± 0.07^{a}	2.30± 0.07^{b}	2.56± 0.24^{bc}	11.85± 1.87^{ab}	12.86± 0.50^{ab}
15	53.20± 0.70^{ab}	53.73± 0.20^{ab}	3.14± 0.21^{a}	3.50± 1.02^{a}	3.13± 0.28^{a}	3.55± 0.18^{a}	3.06± 0.20^{a}	3.83± 0.25^{a}	3.27± 0.77^{a}	3.90± 0.14^{a}	12.09± 0.82^{a}	14.73± 0.75^{a}
16	53.56± 0.52^{ab}	54.20± 0.58^{ab}	3.31± 0.27^{a}	3.50± 0.41^{a}	3.13± 0.28^{a}	3.55± 0.18^{a}	3.28± 0.51^{a}	3.90± 0.25^{a}	3.13± 0.20^{a}	3.45± 0.26^{bc}	12.80± 0.92^{a}	14.46± 0.97^{a}
17	54.03± 0.58^{a}	56.03± 0.27^{a}	3.70± 0.64^{a}	3.58± 0.72^{a}	3.15± 0.49^{a}	3.63± 0.42^{a}	3.60± 0.28^{a}	3.90± 0.46^{a}	3.31± 0.55^{a}	3.92± 2.67^{a}	13.81± 0.72^{a}	14.98± 2.84^{a}
Overall mean	51.87± 0.22^{B}	52.93± 0.27^{A}	2.87± 0.22^{B}	3.90± 0.20^{A}	2.75± 0.08^{B}	3.31± 0.11^{A}	2.87± 0.11^{B}	3.25± 0.15^{A}	1.88± 0.09^{B}	2.40± 0.11^{A}	10.48± 0.25^{B}	12.16± 0.29^{A}

a,b,c,d,e and f Means within each column for each item with different superscripts are significantly different ($P \leq 0.05$)
A and B Overall means of chicken strains under each item with different superscripts are significantly different ($P \leq 0.05$)

Table (3): Macroscopic fertility and hatchability for Baheij (BG) and Bandarah (BN) chicken strains as affected by flock age

Traits / Age (month)	Fertility%		Hatchability of fertile eggs%		Hatchability of total eggs%	
	BG $\overline{X}$ ±S.E	BN $\overline{X}$ ±S.E	BG $\overline{X}$ ±S.E	BN $\overline{X}$ ±S.E	BG $\overline{X}$ ±S.E	BN $\overline{X}$ ±S.E
8	94.22±0.19a	96.49±0.40a	91.63±0.56a	94.75±0.73a	86.30±0.28a	91.44±0.72a
9	92.44±0.58ab	93.31±1.10b	91.38±0.40a	89.66±1.07b	84.45±1.19ab	83.68±1.07b
10	91.91±0.81b	92.25±0.78bc	90.37±0.72ab	89.57±1.22b	83.07±0.52bc	82.61±1.01bc
11	91.23±0.67bc	91.57±0.97bc	89.52±0.41ab	89.30±0.78b	81.69±1.24cd	81.77±0.72cd
12	90.33±0.92bc	91.48±0.52bc	89.30±0.91abc	88.37±0.78b	80.67±0.88cd	80.85±0.93cd
13	90.27±0.56bc	89.77±0.64cd	88.46±0.49bcd	88.30±1.03b	79.85±0.55de	79.25±0.92d
14	89.17±0.64cd	87.70±0.72de	87.23±0.86cd	86.47±0.88bc	77.77±0.77ef	75.78±0.40e
15	87.93±0.55de	85.65±0.83e	85.47±0.48de	84.17±0.65c	75.17±1.17g	72.17±0.60f
16	86.30±0.35ef	82.47±0.10f	84.13±0.58e	80.40±1.42d	72.63±1.52g	66.33±0.81g
17	85.07±0.64f	78.37±1.50g	80.33±1.17f	77.33±1.33e	68.37±0.86h	60.60±0.85h
Overall mean	90.19±0.49A	88.77±0.76B	88.12±0.60A	86.79±0.71B	79.57±0.94A	77.23±1.21B

a,b,c,d,e and f Means within each column with different superscripts are significantly different ($P \leq 0.05$)
A and B Overall means of chicken strains under each item with different superscripts are significantly different ($P \leq 0.05$)

Table (4): Correlation coefficients between the studied parameters of Bandarah strain above diagonal and Baheij strain below diagonal

Bandarah	E.W (gm)	E.W.L% (0 --- 18day)	SH.TH(mm)	SH.M(mm)	Fertility%	H.F.E%	H.T.E%	SH.W (gm)
E.W	----------	- 0.074	- 0.289**	- 0.198**	- 0.373**	- 0.367**	- 0.383**	0.665**
E.W.L% 0 –18day	- 0.054	-----------	0.108	0.009	0.046	0.054	0.087	- 0.026
SH.TH	- 0.429**	0.249**	-------------	0.464**	0.653**	0.614**	0.685**	- 0.352**
SH.M	- 0.292**	0.178**	0.558**	------------	0.474**	0.464**	0.472**	- 0.197**
Fertility	- 0.530**	0.188**	0.696**	0.437**	-----------	0.973**	0.952**	- 0.489**
H.F.E	- 0.499**	0.194**	0.745**	0.449**	0.950**	------------	0.941**	- 0.441**
H.T.E	- 0.495**	0.197**	0.743**	0.502**	0.878**	0.907**	-----------	- 0.489**
SH.W	0.675**	0.052	- 0.383**	- 0.236**	- 0.455**	- 0.440**	- 0.409**	------------
Baheij	E.W	E.W.L%	SH.TH	SH.M	F%	H.F.E%	H.T.E%	

**Significant at ($P \leq 0.01$)
E.W:- Egg weight ; E.W.L%:- Egg weight loss percentage ; SH.TH -Shell thickness ; SH.M:-Shell membranes thickness ;
H.F.E:-Hatchability of fertile eggs ; H.T.E:-Hatchability of total eggs ; SH.W:- Shell weight

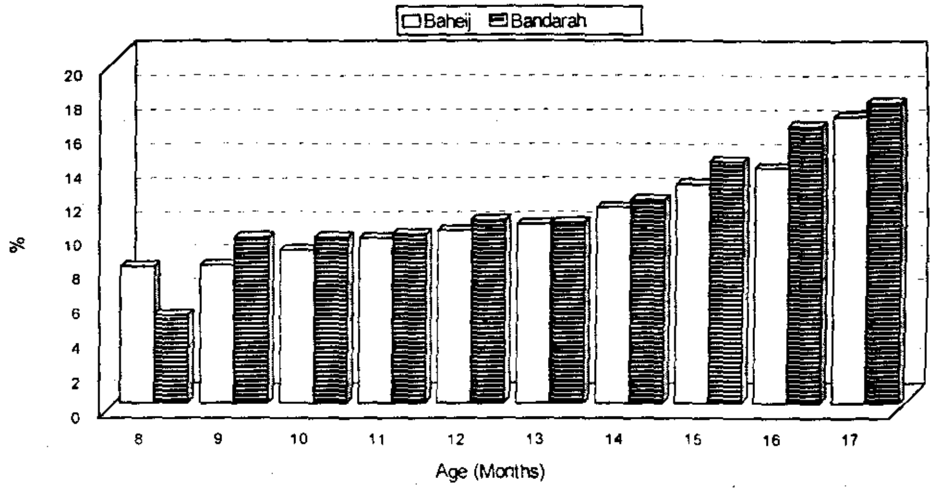

Figure (1): Percentage of total embryonic mortality during incubation period among different flock ages.

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الملخص العربي

علاقة قشرة البيض وأغشية القشرة بالتطور الجنينى خلال فترات مختلفة من إنتاج البيض لسلالتين مستنبطتين من الدجاج

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أجريت التجربة فى محطة بحوث الدواجن بالصبحية – معهد بحوث الانتاج الحيوانى. إستخدم فى هذة الدراسة عدد ٣٠ ذكر و٣٠٠ دجاجة من سلالتى بندرة وبهيج وذلك عند عمر ٣٢ أسبوع (٨ شهور) وذلك لدراسة التأثير المحتمل لسمك أغشية قشرة البيض إضافة لسمك قشرة البيض عند أعمار مختلفة أثناء إنتاج البيض على الفقد فى وزن البيض أثناء التحضين وعلى صفات التفريخ والنفوق الجنينى لكل شهر خلال الحياة الانتاجية وذلك لكلا السلالتين. تم إستخدام عدد ٦٠٠٠ بيضة تفريخ وذلك من عمر ٨ – ١٧ شهر للقطيع بالاضافة إلى ٣٠٠ بيضة من كل سلالة وذلك لدراسة مقاييس قشرة البيض والأغشيه وذلك شهريا خلال عشرة شهور من الحياة الانتاجية للدجاج.

أشارت أهم النتائج المتحصل عليها إلى :--

١ – لوحظ أن سمك أغشية قشرة البيض وكذلك سمك قشرة البيض لسلالتى بندرة وبهيج كانت أكثر سمكا معنويا ($P\leq 0.05$) فى الشهور الأولى من إنتاج البيض عنها فى الشهور المتأخرة من إنتاج البيض وذلك يعطى دلالة على الاتجاة إلى نقصهما بتقدم العمر.

٢ – سجلت سلالة بهيج زيادة معنوية ($P\leq 0.05$) لسمك أغشية قشرة البيض وكذلك قشرة البيض مقارنة ببيض سلالة البندرة.

٣ - أثر زيادة العمر على صفة الفقد فى وزن البيضة فى الفترة من (صفر - ١٨ يوم) خلال فترة التفريخ حيث زادت تلك الصفة معنويا ($P \leq 0.05$) فى الشهور الأخيرة من إنتاج البيض مقارنة بالشهور المبكرة والمتوسطة من إنتاج البيض ويرجع ذلك إلى التفاعل والتغير فى كل من أغشية وقشرة البيضة بتقدم العمر اللذان يؤديان إلى الزيادة فى فقد الرطوبة من البيض أثناء الشهور الأخيرة من إنتاج البيض.

٤ - البيض الناتج من الأمهات الأصغر عمرا أظهر زيادة معنوية ($P \leq 0.05$) فى نسبه الفقس للبيض الكلى والمخصب وذلك لكلا السلالتين المستخدمتين مقارنة ببيض الدجاجات المتقدمة فى العمر (١٦ – ١٧ شهر من العمر) وهذا الانخفاض الناتج عن التقدم فى العمر كان إنخفاضا حادا. وقد تفوقت سلالة بهيج معنويا على سلالة البندرة ($P \leq 0.05$) فى كل من صفة الخصوبة الظاهرية ونسبه الفقس للبيض المخصب والبيض الكلى وقد يرجع ذلك إلى النقص فى سمك أغشية قشرة البيض وقشرة البيض الذى يؤثر على الفقد فى وزن البيض أثناء التفريخ مما يؤثر على إنخفاض نسب الفقس.

٥ – أثبتت الدراسة أنة بتقدم عمر القطيع فى سلالتىالبهيج والبندرة يزداد النفوق الجنينى من ٧.٨٩%, ٥.٠٦% عند عمر ٨ شهور إلى ١٦.٧٣% و ١٧.٥٥% عند عمر ١٧ شهر من العمر لكلا السلالتين على التوالى.

٦ – اثبتت الدراسة أن الارتباط بين سمك أغشية قشرة البيض وسمك قشرة البيض كان موجبا وذو معنوية عالية ($P \leq 0.01$) فى سلالة البندرة (٠.٤٦٤) وسلالة بهيج (٠.٥٥٨). كما أشارت النتائج أن هناك إرتباط بين سمك أغشية القشرة والصفات الأخرى المدروسة مثل الفاقد فى وزن البيض والنفوق الجنينى والفقس.