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EFFECT OF EGGSHELL CONDUCTANCE CONSTANT ON EMBRYONIC INTESTINE FUNCTION, HATCHING CHARACTERS AND SUBSEQUENT GROWTH FOR DEVELOPED CHICKENS AND ITS RELATION WITH 2- FLOCK AGE

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ABSTRACT: The present experiment was carried out for studying the effect of eggshell conductance constant (K) on embryonic intestinal function, hatching success, some physiological parameters and post-hatch growth for two flock ages (39-42 vs. 59-62 wks) of Gimmizah breed. The obtained results are summarized as follows: Gimmizah older chickens had higher significant records with respect to pore number and radius of eggshell, egg weight loss % during setting phase of incubation, hatch time and eggshell conductance either in dessicator or incubator and conductance constant and thinner eggshell thickness compared to younger ones. Embryonic mortality was significantly increased for eggs produced from older flock age. Whereas, hatchability percentage, yolk free chick body weight, relative intestinal weight, lengths of duodenum, jejunum and ileum and jejunum maltase enzyme value, relative heart weights besides glycogen values were significantly increased for younger flock age. Triiodothyronine and corticosterone hormones and some hematological parameters i.e. RBCs, Hb and PCV% were decreased ($P \leq 0.05$) for embryos and hatched chicks for older flock age. The results proved that younger flock age had a positive effect on eggshell conductance and conductance K which played a cardial role on hatching process, intestinal function, chick body weight and post-hatch growth. Therefore, it is hoping that using the dessicator for determining the eggshell conductance before incubation is useful tool for selecting the suitable senario of incubation condition including temperature and relative humidity to realize the best results of hatching out-put and growth of hatched chicks.

Key words: Flock age, Conductance, Hatchability, Hormone, Chick growth.

INTRODUCTION

The avian eggshell is porous to allow the entrance of oxygen for the respiration of the embryo and elimination of the carbon dioxide produced (Tullett and Deeming, 1982). Eggshell structure influences its function as an embryonic respiratory component , therefor, it is necessary to examine eggshell quality and its relation with hatchability through a measurement that describes the shell 's dynamic respiratory quality and this physiological function of the shell has been described by its water vapor conductance (G_{H2O}) (Peebles and McDaniel, 2004). Eggshell conductance and the inside partial gas pressure in the egg are the major players in the exchange process of water vapor, O_2 and CO_2 , also, the established period with a maximal exchange rate is called the plateau phase and limited by G_{H2O} (Bamelis et al., 2008). The main limiting features of gas exchange are shell thickness , porosity, pore number and pore diameter (Morita et al., 2009). Christensen and Nestor (1994) showed that the equation summarizing the functional characteristic of incubating eggs that determines the energetics and water budget defines a conductance constant (K) and the K allows the functional properties to be measured in terms of physical properties, i.e. egg weight and incubation period, whereas G_{H2O} measures functional eggshell properties. The concept of eggshell conductance constant may have an impact on intestinal and cardiac physiology, hatch time, hatchability and poultry production (Christensen et al., 2003 a and b and 2006).

Many investigators detected that flock age has important effect on eggshell characteristics (Tona et al., 2004), pore diameter(Christensen and Nestor,1994), shell thickness (Rizk et al ., 2008), eggshell conductance and conductance constant (Christensen et al.,1996 and 2001), hatch time , hatchability and some blood parameters (Mona et al., 2016) and post- hatch growth (Ipek and Sozcu, 2015).

This study was undertaken to assess the role of eggshell conductance constant (k) on eggshell quality, embryonic intestinal function, hatching power, blood parameters and post -hatch growth for two flock ages of Gimmizah chicken breed.

MATERIALS AND METHODS

The present study was carried out at El-Sabahia Poultry Research Station, Animal Production Research Institute, Agricultural Research Center.

Experimental Design:

Nine hundreds hatching eggs produced from Gimmizah hens representing two ages were incubated at the same time in one incubator. The first group of eggs was produced from younger hens aged 39 to 42 wks and termed as prime time of chicken's life. The second one was produced from older hens which aged 59-62wks. Forty hundred and fifty hatching eggs represented each age stage were divided into three replicates and stored for 6 days in ventilated room with 20 ± 2^0C temperature and 60±2% relative humidity (RH). All eggs were individually numbered and weighed prior to the beginning of the incubation and incubated in Egyptian made incubator at 99.5Ḟ and 55% RH during setting phase and 98.6Ḟ and 65% RH during hatching phase . The time of setting eggs in the incubator was recorded to obtain the hatch time exactly in hours and considered as zero hours of experiment.

Measurements:

Thirty hatching eggs representing each age were weighed and put in glass dessicator before setting in the incubator for determination eggshell conductance (G_{H2O} mgH_2O/day/Torr) according to the method described by Peebles and McDaniel (2004). Also, extra three hatching eggs representing each replicate for each flock age after the same storage period were taken to estimate the following parameters: eggs weight to nearest 0.1 gm and eggshell thickness without membranes by a micrometer to the nearest 0.01 mm (pore length). Furthermore, pore radius (µm) was measured by scanning with electron microscope at Faculty of Science, Alexandria University. Pore numbers in eggshell were calculated using the following equation according to Rahn and Paganelli (1990):

Pore number $=304W^{0.767}$

where: W= egg weight.

At 18th day (432 hrs) of incubation, the eggs were individually weighed (gm) and the percentage of egg weight loss was calculated during the setting phase of incubation (0-18 d). Eggs were candled and those with evidence of living embryos were transferred to the hatcher with the same experimental design. The infertile clear eggs were macroscopically evaluated to determine apparent infertility by naked eyes. Beginning at 456 hrs of incubation and at 12 hr intervals thereafter the hatcher was opened and chicks that had fully emerged from eggs were removed, wing banded and returned again to the hatchery. Hatch time and body weight for all chicks at the time of removal from the hatcher were recorded. Hatchability was calculated as the percentage of sound hatched chicks from fertile eggs. Eggs that failed to hatch at the end of incubation and having full opportunity for hatch were broken out and then examined with naked eye to estimate embryonic mortality during intervals (early)1-7, (mid) 8-14 and (late) 15-21 days of incubation.

At the beginning of 18th day of incubation, all eggs were weighed again to determine the G_{H2O} in the incubator using data and the calculations in the chart as mentioned by Pulikanti et al. (2011). Eggshell conductance constant K was calculated by matching G_{H2O} with the length of incubation (days) divided by egg weight.

Three embryos from each replicate were taken at the 19th day of incubation. Besides, three hatched chicks from each replicate were weighed and slaughtered. Abdominal cavity was opened, residual yolk was removed and yolk free chick body weights (gm) were recorded. Relative weights of intestine to embryos without yolk at day 19 of incubation and for free yolk hatched chicks were detected. Also, the unstreched lengths of each intestine segment (duodenum, jejunum and ileum) were measured by centimeter. Jejunum section was immediately frozen in physiological saline and assayed for maltase activity (µ mol/min/jejunum) at Animal Health Research Institute according to the method of Christensen et al.(2003a).

Relative heart weight to embryos without yolk at day 18 and for free yolk hatched chicks were recorded and immediately used for evaluation the proportional changes in glycogen concentration (mg/g of wet tissue mass) .

Blood samples were taken from embryos at day 19 of incubation and slaughtered chicks then immediately collected in heparinized tube for counting red blood cells (RBC_s $10^6 \times mm^3$), hemoglobin (Hb

g/dl) and hematocrit (PCV%) . Plasma triiodothyronine (T_3) ng/mL, corticosterone (ng/mL) and lactate dehydrogenase (LDH) IU/L were detected by available commercial diagnostic kits for embryos at days 18 and 19 and for hatched chicks.

All hatched chicks representing the experimental two flock ages were individually weighed and distributed in batteries. Chicks were raised up to six wks of age and fed starter diet containing 20% CP, ME of 2900 k cal/ kg diet. Feed and water were offered *ad libtum* along the experimental period (1-6 wks of age). Feed consumption (gm) and chick body weight (gm) were recorded. Also, body weight gain (gm) and feed conversion ratio (gm feed/ gm gain) were calculated at the end of the experimental period.

Statistical analysis:

Data obtained were statistically analyzed using General Linear Models (GLM) of SAS (2004). The significant differences among treatment means were tested according to Duncan (1955).

The flowing model was used

$Y_{ijk}= \mu+L_i+ e_{ijk}$

Y_{ijk}= observed traits

μ= the overall mean

L_i= flock age effect

e_{ijk}= random error.

RESULTS AND DISCUSSION

Eggshell conductance:

Data of Table 1 represent the effect of Gimmizah chicken age on initial egg weight (gm), shell thickness (mm), pore radius (µm), pore number, egg weight loss %during incubation period (0-18d), eggshell conductance (G_{H2O}), hatch time (hrs) and eggshell conductance constant (K).Eggs produced from older flock age represented significant ($P\leq0.05$) increase for all previous studied parameters except for eggshell thickness compared to those for younger one. While, shell thickness had opposite trend as it increased ($P\leq0.05$) for younger age. The decrease of shell thickness and the increase of all the rest parameters are followed the increase of egg weight produced form older chickens. The egg weight increases with the hen age is due to the increase of yolk, albumen weight and yolk proportion (Suk and Park, 2001). Different researches supported the results herein such as Rizk et al.(2008) who detected that chicken age had negative effect on shell thickness . Moreover, Tullett (1981) indicated that pore geometry has been shown to be related to egg weight and changes in shell porosity have been seen among flocks as the flock ages. Besides, the pore structure and pore dimensions can also increase with the increase of egg mass (lynn, 2006).Also, Rayan and Badri (2017) showed that total pores per egg produced from older layer age were significantly higher than those for younger ones.

The significant reduction of weight loss % for eggs produced from younger hens compared to those for older ones could be related to egg weight, shell thickness, pore number and pore radius and these conclusions were previously documented by Rizk et al. (2008) and Rayan and Badri (2017) who stated that eggs produced from older hens had less shell thickness and consequently egg weight loss increase compared with those for younger ones. In addition to, the loss of water vapor depends upon the geometry of the pores and the water vapor pressure between the insides of the eggshell and ambient vapor pressure in the incubator (Rahn, 1981).

Also, the increase of water vapor conductance in the larger eggs for older hens in the current data could be related

to the increase of egg surface area (Lynn, 2006), flock age (Celen et al., 2009) pore numbers and areas (Christensen and Nestor, 1994) and is inversely related to shell thickness (Lynn, 2006).

The younger age used in this experiment could be termed as prime age comparable with the older one and this age realized the best results of G_{H2O} and K. The conductance during the laying cycle had been demonstrated by French and Tullett (1991) who showed that G_{H2O} increased in the first half of the laying cycle then became moderate and constant and increased again at the end of laying cycle. Furthermore, egg weight loss and its relation with the function of G_{H2O} is documented by Wesam et al. (2015).

The increase of hatch time for eggs of older flock (Table 1) compared to younger one is previously supported by Hamidu et al.(2007) and Mona et al.(2016). Contradictory results were reported by Bruzual et al.(2000) who found that hatching time was not affected by hen age.

The relation of egg weight, hen age, hatch time and G_{H2O} could be explained on the light of plateau stage of embryogenesis as demonstrated by Rahn (1981) who characterized this stage with losing 15% as water vapor, shell conductance with 100 ml of oxygen per gram of initial egg weight and 14% partial pressure of oxygen within the air space and carbon dioxide reaches a value of 6%, these common characteristics must happened to start the internal pipping. So the time of pipping can be retarded by decreased CO_2 and increased O_2 concentration in the air space (Burton et al., 1989). Besides, French and Tullett(1991) found that high conductance eggs lose much CO_2 from the egg leading to hypocapnia then retarded the time of hatch.

The current results of conductance constant (K) increase with the advancing age are in accordance with that reported by Christensen and Nestor (1994).

Therefore, the conductance constant (K) could be used as functional properties measure for eggshell and mirror of the physical properties which predispose embryos to hatch.

Hatching traits:

Effects of chicken age with reference to G_{H2O} on embryonic mortality %, hatchability of fertile eggs % and hatched chick body weight (gm) either with or free from yolk sac are summarized in Table 2 . Embryonic mortalities % for early and late stages of incubation and hatched chick body weight with yolk were significantly ($P \leq 0.05$) increased for older chickens group compared with those for younger one. While, higher significant ($P \leq 0.05$) for hatchability of fertile eggs% and hatched chick body weight yolk free were recorded for younger chickens compared with those for older ones. Embryonic mortality % at mid stage of incubation did not statistically differ between experimental ages.

The results of increasing embryonic mortality for eggs produced from older hens are in harmony with those previously reported by Rizk et al.(2008) and Mona et al.(2016). The increase of late embryonic mortality with the increase of chicken age might be due to the increase of surface area for eggs of older hens (Celen et al., 2009). Also, Hamidu et al.(2007) showed that parent flock age affects daily embryonic metabolism which coincides with greater embryonic mortality during the late incubation period. The results of significant increase of hatchability % for younger flock age compared to older one

are documented and could be related to decrease of eggshell thickness (Tsarenko, 1998), decrease in functional eggshell qualities (Christensen and Nestor, 1994), albumen quality deterioration (Tona et al., 2004), the decrease of embryonic mortality (Mona et al., 2016). It seems that egg weight increase for older flock in the current study could be the reason of chick weight with yolk increase compared with those for younger ones. These results are confirmed by Rizk et al.(2006) and Celen et al.(2009) who reported that there is a positive linear correlation between egg weight and hatched chick weight with yolk.

It could be noticeable from data of this table that chick body weight with yolk was significantly ($P \leq 0.05$) increased with the increase of flock age, while in case of subtracting yolk sac from the hatched chick, the chick weight was decreased for older flock compared to younger one. Therefore, it is concluded that the increase of chick body weight for older flock is not real increase as the yolk sac will be consumed later at the early chick life. The trend results of increasing embryonic mortality % and decreasing both of hatchability% and yolk free chick body weight at hatch for older flock could be affected by the increase of G_{H2O} and weight loss% as previously illustrated in Table 1. Different researches were published to support this notion as Rizk et al.(2008) indicated that incubation water loss is determinant for embryonic mortality and hatchability. Moreover, Bamelis et al.(2008) pointed out that increasing G_{H2O} may be the reason of lowering embryonic growth rate and increasing embryonic mortality. Also, French and Tullett (1991) suggested that eggshell conductance could play a cardial role of hatchability and could be maintained across a broad range of medium conductance and affected mainly by hen age. Tazawa and Whittow (1998) mentioned that the maximum O_2 uptake of the egg (M_{O2}) at medium G_{H2O} is considered to be optimal for chick development and the decrease of M_{O2} at both higher and lower G_{H2O} as a sign of compromised development and will be the reason for mass reduction of embryos. Thus the relationships between the studied parameters such as egg weight, eggshell conductance and hen's age should be taken into consideration for discussing their effects on hatching out-put.

Intestinal parts and maltase activity:

Effects of chicken age with reference to G_{H2O} on relative intestinal weight, length of intestine parts and jejunum maltase enzyme activity for embryos at the 19th day of age and for hatched chicks are presented in Table3. Embryos aged 19 days and hatched chicks produced from younger chickens represented significant ($P \leq 0.05$) increase for each of relative intestinal weight to yolk free body weight, length of intestinal parts and jejunum maltase enzyme activity compared to those for older ones. Taken together, the trend of the mentioned studied parameters increase with the results of G_{H2O} and hatch time in Table1 could be explained on the light of previous statement reported by Wesam et al.(2015) who showed that either high conductance or egg weight depressed intestinal maturation and its growth at hatch. Also, Christensen et al. (2003a) indicated that depressed embryonic intestinal weight was similarly followed by depressed body weight and growth efficiency post hatching. The rapid increase in intestinal mass and length ensure that the animal is ready to meet the

increase demand of nutrients to maintain tissue (Ferrais and Diamond, 1997). Also, intestinal function is essential to post embryonic development in avian species and exhibits straight line growth with the body (Konarzewski et al., 1990). So, the significant increase of relative weight, lengths and maltase activity for embryos and chicks produced from younger chickens (Table3) could be the reason of nutrients absorption improvement and in turn increase of hatched body weight free from yolk. In addition, Pinchasove and Noy (1993) reported that physiologic maturation of the gastrointestinal tract occurs mainly through increased production of intestinal enzymes such as maltase enzyme. The significant increase of K values for eggs produced from older chickens (Table1) could be related with the significant decrease of relative intestine weights, length of intestinal parts and jejunum maltase enzyme activity of embryos and hatched chicks (Table 3). This relation could be explained through the delay of hatch time as the chicks spent more time in plateau phase, so they take more energy for survival during the hypoxia of plateau phase for covering demands of pipping and hatching more than intestinal maturation. These explanations are in harmony with that mentioned by Lynn (2006) and Wesam et al. (2015) who suggested that optimal intestinal development and growth may be dependant upon larger or shorter developmental periods as determined by K. Also, Christensen et al. (2003a) pointed out that increasing of K may diminish energy availability and delay intestinal maturation post hatching because 60% of the total energy of a neonate may be devoted to maturation and growth of intestinal tissue in the first few days following hatching.

Heart weight, glycogen and lactate dehydrogenase:

Results of Table4 show the effect of chicken age with reference to G_{H2O} on relative heart weight to yolk free body weight, cardiac glycogen and plasma lactate dehydrogenase enzyme activity (LDH) for embryos at day 18 of incubation and hatched chicks. Significantly higher ($P \leq 0.05$) relative heart weight and cardiac glycogen concentration were observed for embryos and hatched chicks produced from younger chickens compared to those for older ones. In opposite trend, embryos and hatched chicks produced from older flock had higher ($P \leq 0.05$) values of LDH compared to younger one. The results of increasing relative heart weights and cardiac glycogen for embryos produced from younger chickens are in harmony with those reported by Christensen et al. (1996) who found that relative heart weight was significantly increased at plateau stage for embryos produced from chickens aged 39-44 wks. Also, the same authors indicated that cardiac glycogen concentrations were greater in the embryos from the younger hens. The current results of G_{H2O} and K increase besides longer hatch time for eggs of older age as shown in Table 1 could be the reasons of relative heart weight and cardiac glycogen depression and elevation of LDH activity. Supporting to this explanation, Christensen et al.(2005) showed that average G_{H2O} elevated heart weight and cardiac glycogen. Moreover, Cristensen et al.(2003b) indicated that LDH can be elevated by cardiac insufficiency. In addition, Christensen et al. (2001) mentioned that slower growth in heart was accompanied by a longer

incubation period and when embryo is experiencing longer hypoxia at the plateau stage with its consequent anaerobic metabolism, reduce heart growth may occur because of insufficient carbohydrate metabolism in cardiac tissue.

Blood parameters:

Data of Table 5 shows the values of Hb (g/dL), PCV% and RBCs count for embryos at day 19 of incubation and for hatched chicks. Values of Hb, PCV% and RBCs count for either embryos or hatched chicks produced from younger chickens were significantly ($P \leq 0.05$) higher than those observed for older one. Aforementioned results are in harmony with the results of Luquetti et al. (2004) who found that chicks produced from older chickens (60- wk) had lower number of RBCs, Hb and PCV % than those produced from 45 –wk of old. Also, the blood parameters of embryos and hatched chicks could be due to the maternal effect inherited from the mothers. So, the significant increase of the measured blood parameters for embryos and hatched chicks is explained by Peebles et al.(2007) and Bergoug et al.(2013) who confirmed the role of the parents flock (40 wks age) as younger age accompanied with highest egg production. The apparent decrease of eggshell conductance for younger group compared with older one as previously mentioned could play a part in the increase of the studied blood parameters and this result is keeping with those previously stated by Tazawa and Whittow(1998) who mentioned that in eggs whose shell conductance is low the PCV% and Hb increases to hypoxia.

Plasma triiodothyronine (T_3) and corticosterone hormones:

Effects of chicken age with reference to G_{H2O} on plasma T_3 and corticosterone hormones for embryos at days 18 and 19 of incubation beside hatched chicks are illustrated in Figure 1. Both concentrations of hormones records were significantly ($P \leq 0.05$) higher values for embryos and hatched chicks produced from younger chickens than those for older ones. The results of significant increase of plasma T_3 hormone for hatched chicks of younger chickens group are keeping with that previously mentioned by Mona et al. (2016). Also, this hormonal increase may be due to maternal effect and this statement is confirmed by McNabb and Wilson (1997) who mentioned that younger hens may deposit more thyroid hormones into developing eggs. Also, Christensen et al. (2002) stated that maternal thyroid can influence the maturation of vital tissues during the final stages in ovo life. Furthermore, Eshratkhah et al. (2011) pointed that chicken age had significant effect on thyroid hormones and the variation of these hormones depend on the metabolic demands. Also, the obtained results of G_{H2O} with average value related with the increase of hormonal levels are in harmony with those stated by Christensen et al (2006) who mentioned that the embryos produced from average G_{H2O} had the highest T_3 level.

The increase of T3 and corticosterone hormones for embryos and hatched chicks of younger flock could be the reason of earlier hatch time (Table1) and increased hatchability (Table 2). These results are supported by many documents as Christensen et al.(2002) found that longer incubation periods have been

related with the reduction of embryonic thyroid function. Moreover, the peak in thyroid hormone concentration coincides with a time of plateau phase in O_2 consumption identified by hypoxic and hypercapnic condition created for embryos (Wineland et al., 2006) and an increase in G_{H2O} decreases PCO_2 in the air cell (Tona et al., 2003 a). So, higher PCO_2 and decreased PO_2 in the cell is known to be stimulus for higher concentration of plasma T_3 and corticosterone leading to the initiation of chicks hatching process early (De Smit et al., 2006). Moreover, the interval between internal and external pipping beside the improvement in hatchability are T_3 dependent (Decuypere et al., 1991). Also, the same authors showed that corticosteroids are known to stimulate thyroid metabolism in chicken embryo which is related to the hatching process by the stimulatory hepatic 5- D activity and increasing the converting T_4 to T_3, in addition to, glucocorticoids and thyroid hormones are involved in preparation for hatching by the increased blood supply of lungs as in the development of the surfactant system in the embryonic lung and increased the phospholipid in the lung which stimulate the production of ornithokinin enzyme which induce the process of internal and / or pipping early.

The obtained results of increasing intestinal weight, length and maltase activity (Table3), heart weight (Table 4) and yolk free chick body weight (Table 2) combined with increasing of T_3 hormone are in harmony with that previously reported by Suvarna et al. (1993) who stated that thyroid and adrenal hormones play major roles during plateau phase in maturation and differentiation of intestine cell. Also, Lynn (2006) found relationship between intestinal enzyme (maltase) and thyroid production. Additionally, Christensen et al. (1996) showed that thyroid hormones influence the heart growth. Moreover, Decuypere et al. (1991) stated that retraction of yolk sac has been linked with thyroid hormones.

Post- hatch growth:

Results of post- hatch growth of Gimmizah chicks during the first six weeks of age as influenced by chicken age are shown in Table 6. Chicks produced from younger flock age surpassed ($P \leq 0.05$) those from older one with respect to body weight gain with more feed consumption and better feed conversion during the experimental periods.

Previous works regarding the effect of breeder flock age on post-hatch growth had variable results. Supporting to our results, Ipek and Sozcu(2015) found that chicks produced from younger breeder age had higher body weight gain compared to those produced from older one. Also, Hulet et al.(2007) pointed out that chicks produced from younger breeder flock had the better cumulative feed conversion values compared to older one. While, Schaefer et al.(2006) and Onbasilar et al.(2008) showed that body weight, body weight gain , feed consumption and conversion were not affected by breeder flock age. Contrary to the current results, Peebles et al. (1999) detected that chicks produced from younger hens had lower body gain than those for older one.

The apparent increase of chick weight with the increase of egg weight for older flock age as previously documented in Table 2 is deceptive result due to yolk sac which adds extra weight to the body of hatched chicks. Therefore, the primary causes of feed consumption increase and

improvement of weight gain for chicks of younger flock age who have lesser weight at hatch compared to those for older one are the enhancement of embryonic intestine and metabolic functions which reflected on the rapid consumption of yolk sac for embryos and consuming more amount of feed during the early chick life and consequently body weight gain and feed conversion improvement.

In addition, The increase of body weight gain for chicks produced from younger chickens could be due to the eggs of younger breeder age had the best G_{H2O} and in turn shorter hatch time (Table1), increasing intestinal weight, length and maltase activity (Table3), higher yolk free body weight (Table2) , improvement in cardiac development (Table4) and finally reflected on post-hatch growth. These conclusions are keeping with those reported by Palo et al.(1995) and Cristensen et al.(2003a) who showed that the early development of gastrointestinal tract before hatching has a major role in chick growth during the post-hatch growing period. Also, Tona et al.(2003b) detected that negative relationship between incubation duration and chick growth. Furthermore, Wesam et al.(2015) found that eggs with best G_{H2O} had the highest post-hatch growth.

IN CONCLUSION

Based on the former results, it is suggested that eggshell conductance constant and parent flock age have to be taken into account during incubation in order to design senario for optimal incubation condition including humidity and temperature to attain good results of hatch and best physiological response of hatched chicks and these results will brought great potential for post-hatch growth.

Table (1): Effect of Gimmizah chickens age on eggshell measurements, egg weight loss , shell conductance, hatch time and conductance constant (K)[1]

Chicken age interval (WK)	Initial egg weight before incubation (gm)	Shell thickness (mm)	Pore radius (µm)	Pore number	Egg weight loss% (0-18 days)	Eggshell conductance (mg H_2O/day/torr)		Hatch time (hrs)	Conductance constant (K)
						Dessicator	Incubator		
39-42	52.84± 0.24[b]	0.41± 0.01[a]	32.75± 0.28[b]	6373.62± 21.87[b]	10.88 ± 0.25[b]	14.53± 0.15[b]	13.99± 0.02[b]	495.66± 1.63[b]	5.46± 0.01[b]
59-62	55.03± 0.24[a]	0.37± 0.01[b]	52.25± 0.21[a]	6575.27± 22.1[a]	12.87± 0.23[a]	16.99± 0.18[a]	17.25 ±0.18[a]	501.33± 1.08[a]	6.54± 0.06[a]

$K^1 = G_{H2O} \times$ hatch time (days)/ egg weight at setting (gm)

a and b Means within each column with different superscripts are significantly different ($P \leq 0.05$)

Table (2): Effect of Gimmizah chickens age with reference to conductance (G_{H2O}), on embryonic mortality, hatchability and chick body weight

Chicken age interval (WK)	Embryonic mortality %			Hatchability of fertile eggs (%)	Chick body weight (gm)	
	early (1-7days)	mid (8-14days)	late (15-20days)		Including yolk	Free from yolk
39-42	1.35±0.15[b]	0.68±0.11	4.04±0.23[b]	93.93±0.26[a]	36.51± 0.23[b]	32.64± 0.14[a]
59-62	2.76±0.11[a]	1.04±0.12	6.53±0.46[a]	89.66± 0.66[b]	38.27± 0.18[a]	30.07±0.17[b]

a and b Means within each column with different superscripts are significantly different ($P \leq 0.05$)

Table (3): Effect of Gimmizah chickens age with reference to conductance (G_{H2O}) on intestinal parts and maltase activity for embryos at 19th day and for hatched chicks

Chicken age interval (WK)	Relative Intestine weight		Duodenum length (cm)		Jejunum length (cm)		Ileum length (cm)		Jejunum maltase (µmol/min/jejunum)	
	Embryo at day 19	Hatched chicks	Embryo at day 19	Hatched chicks	Embryo at day 19	Hatched chicks	Embryo at day 19	Hatched chicks	Embryo at day 19	Hatched chicks
39-42	2.17± 0.21[a]	2.75± 0.03[a]	4.11± 0.01[a]	4.49± 0.02[a]	9.38± 0.05[a]	11.47± 0.07[a]	6.32± 0.02[a]	8.40± 0.05[a]	0.25± 0.01[a]	1.75± 0.01[a]
59-62	1.82± 0.04[b]	2.34± 0.02[b]	3.12± 0.01[b]	3.33± 0.01[b]	7.46± 0.02[b]	10.19± 0.04[b]	4.96± 0.01[b]	7.60± 0.12[b]	0.18± 0.01[b]	1.66± 0.01[b]

a and b Means within each column with different superscripts are significantly different (P≤0.05)

Table (4): Effect of Gimmizah chickens age with reference to conductance (G_{H2O}) on Relative heard weight , cardiac glycogen value and lactate dehydrogenase for embryos at 18 day and hatched chicks

Chicken age interval (WK)	Relative heart weight		Cardiac Glycogen (mg/g of wet tissue mass)		Lactate dehydrogenase (LDH) IU/L	
	Embryo at 18 day	Hatched chicks	Embryo at 18 day	Hatched chicks	Embryo at 18 day	Hatched chicks
39-42	0.58 ±0.01[a]	0.76±0.01[a]	4.67± 0.13[a]	3.70± 0.14[a]	180.86 ±8.42[b]	202.40±8.20[b]
59-62	0.41±0.01[b]	0.62±0.01[b]	3.40 ± 0.09[b]	2.50± 0.10[b]	250.76±2.79[a]	279.43± 4.60[a]

a, and b Means within each column with different superscripts are significantly different (P≤0.05)

Table (5): Effect of Gimmizah chickens age stage with reference to conductance (G_{H2O}) on Hb (g/dL), PCV% and RBCs count for embryos at day19 and of incubation and for hatched chicks

Chicken age interval (WK)	Hb (g/dL)		PCV%		RBCs ($10^6 \times mm^3$)	
	Embryo at day 19	Hatched chicks	Embryo at day19	Hatched chicks	Embryo at day 19	Hatched chicks
39-42	11.33 ±0.02[a]	11.45 ±0.02[a]	34.96 ±0.01[a]	35.50 ±0.02[a]	2.62±0.02[a]	2.67± 0.02[a]
59-62	10.27±0.02[b]	10.36±0.02[b]	32.44±0.02[b]	33.11±0.02[b]	2.26 ± 0.02[b]	2.41±0.02[b]

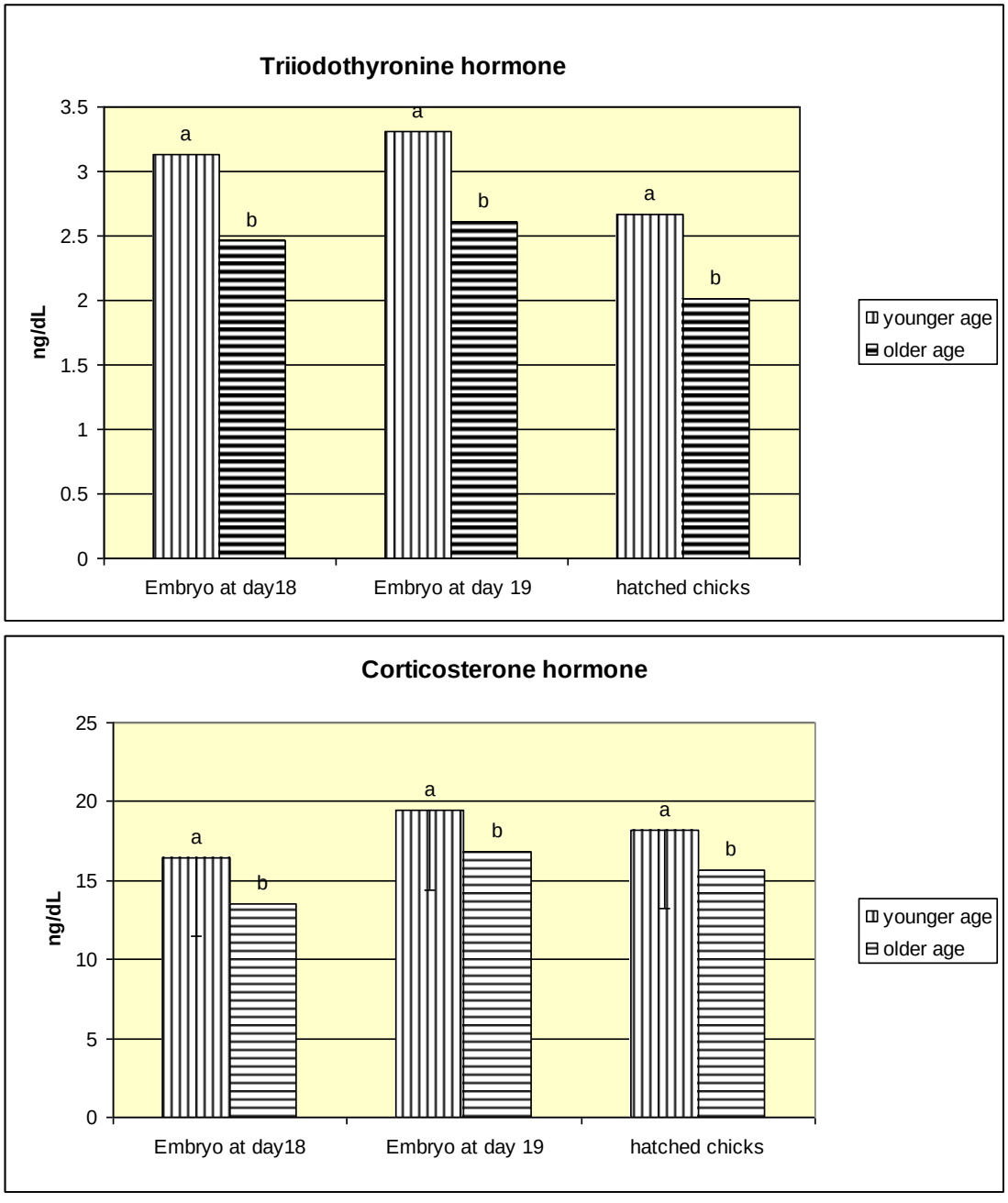
a and b Means within each column for each item with different superscripts are significantly different (P≤0.05)

Table (6): Effect of Gimmizah chickens age with reference to conductance (G_{H2O}) on post- hatched chicks growth during the first 6 weeks of age

Chicken age interval (WK)	Body weight gain(gm)	Feed consumption (gm)	Feed conversion (gm/gm)
39-42	362.44± 5.50[a]	1581.94± 29.16[a]	4.36± 0.10[b]
59-62	312.93± 1.43[b]	1472 .87± 31.08[b]	4.70± 0.12[a]

a and b Means within each column with different superscripts are significantly different (P≤0.05)

Figure (1): Effect of Gimmizah chickens age with reference to conductance (G_{H2O}) on plasma triiodothyronine and corticosterone hormones.



a and b Means having different letters are significantly different ($P \leq 0.05$)

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الملخص العربى

تأثير معامل توصيل قشرة البيض على وظائف أمعاء الأجنة و صفات الفقس و النمو بعد الفقس للدجاج المستنبط و علاقته مع :
2.عمر القطيع

وسام اديب فارس ، منى رفعت محمد أحمد ، رءوف ادوارد رزق، السيد حامد شاهين

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تم اجراء هذا البحث بمحطة بحوث الدواجن بالصبحية ، معهد بحوث الأنتاج الحيوانى و أستهدف دراسة تأثير ثابت معامل توصيل قشرة البيض (K) على وظائف امعاء الاجنة و صفات الفقس و بعض المقاييس الفسيولوجية و كذا نمو الكتاكيت بعد الفقس الناتجة من قطيع دجاج الجميزة لعمرين مختلفين (39-42 ،و 59-62 أسبوع) و تتلخص النتائج المتحصل عليها كالاتى:- سجل البيض الناتج من قطيع الجميزة الاكبر عمرا زيادة معنوية و ذلك لكل من عدد و عرض مسام القشرة، نسبة الفقد فى وزن البيضة خلال فترة التحضين(1-18 يوم) و ميعاد الفقس و معدل توصيل قشرة البيض فى كل من المجفف الزجاجى و خلال فترة التحضين مقارنة بالبيض الناتج من العمر الاصغر. وسجل البيض الناتج من القطيع الاكبرعمرا زيادة معنوية فى النفوق الجنينى مقارنة بالعمر الاصغر بينما سجل البيض الناتج من القطيع الأصفر عمرا تحسنا معنويا فى كل من نسبة الفقس، وزن الكتاكيت الفاقسة بدون صفارو الوزن النسبى للامعاء و أطوال كل من الأثنى عشر و الصائم و اللفائفى و قيمة انزيم المالتيز فى الصائم، و وزن القلب النسبى و قيم جليكوجين القلب مقارنة بالعمر الأكبر.و تناقصت معنويا قيمة كل من هرمونى T_3 و الكورتيكوستيرون و بعض مكونات الدم مثل الهيموجلوبين و حجم و عدد كرت الدم الحمراء للاجنة و الكتاكيت الناتجة من الأمهات الأكبر مقارنة بالعمر الاصغر0 وقد أوضحت النتائج ان عمر قطيع الامهات الاصغر سنا له تأثير ايجابى على كل من توصيل القشرة و معاملة و اللذان يلعبان دورا اساسيا فى عملية الفقس ، ووظائف الأمعاء فى الاجنة و الكتاكيت الفاقسة، وزن الكتاكيت الفاقسة و نموها بعد الفقس و لذلك نأمل فى ان تحديد معدل توصيل قشرة البيض فى المجفف الزجاجى (الناقوسى) قبل البدء فى عملية التفريخ قد يساعد فى تصور السيناريو المناسب لتحديد الظروف الملائمة من حرارة ورطوبة نسبية اثناء التفريخ لتحقيق افضل نتائج للفقس و معدلات نمو الكتاكيت.