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IMMUNOGIOBULIN IgY TRANSFER FROM DAMS TO THEIR EGG YOLKS AND CHICKS IN SOME LOCAL DEVELOPED EGYPTIAN STRAINS

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ABSTRACT: This work was done to investigate the immune fitness of newly hatched chicks in four local improved Egyptian strains using immunoglobulin-Y (IgY) Index transferred from hens through egg yolk to offspring. The strains used were Mandarah, Matrouh, Silver Montazah and Inshas. 36 hens and 9 cocks of 18 weeks old from each strain were used. IgY concentration was determined in serum of hens and newly hatched chicks. Also, the egg yolk was separated to determine IgY levels in egg yolk. The results of Mandarah strain showed the highest concentration ($P \leq 0.05$) of IgY that transferred to egg yolk and offspring, followed by Matrouh, Silver Montazah and Inshas strains that had the lowest ($P \leq 0.05$) concentration of IgY. There was significant positive correlation between the levels of total serum IgY and total yolk IgY level in the four breeds. However, Mandarah strain had the highest positive correlation indicating that Mandarah chicks should have the highest passive immunity against infectious diseases during early life. This may contribute to breeding programs when fitness of the offspring is a concern, as this may affect general health status of birds having high immunity that reduces the use of antibiotics and hence favoring organic production of chicken.

Keywords: Hen - egg yolk – chick – IgY- correlation.

INTRODUCTION

Maternal Immunity can be defined as the transfer of antibodies by an immunocompetent adult female to an immunologically naive neonate transplacentally or through colostrum, milk or yolk (Grindstaff et al., 2003). Neonatal vertebrates have limited ability to synthesize endogenous antibodies (Lawrence et al., 1981). So, the primary form of humoral immunity (antibody-mediated) of offspring early in life are provided by maternally derived antibodies. The persistence of maternal antibodies varies depending on body size and metabolic rate. In chicken, maternal immunoglobulins are catabolized by offspring over the first 14 days post-hatch and consequently after nearly two weeks the circulating antibodies in chicks are mainly endogenous (Grindstaff et al., 2003). A lot of epidemiologic studies have confirmed that maternal antibodies modify the severity of infections caused by respiratory viruses (example Influenza virus) having surface glycoproteins (Glezen et al., 2003). Ahmed and Akhter (2003) have reported that pathogen specific antibodies are transferred from hens to their chicks via the egg to protect the chicks having pathogens. Maternal antibodies affect also the growth and developmental rates of chicks and hence they have an effect on the phenotypic traits of offspring (Gustafsson et al., 1994). Chicken have three classes of immunoglobulins that are IgY, IgA and IgM. Both IgA and IgM are structurally similar to that of mammalian IgA and IgM. However, IgY is equivalent to IgG of mammals, but it is structurally different from mammalian IgG. IgA and IgM are mainly transferred through egg white, while IgY transfers from hens to their offspring mainly through egg yolk (Hamal et al., 2006). The transfer of IgY from dam to her chicks is a two- step process. Firstly, the receptors present on the ovarium follicles pick up IgY from the blood of dams (Locken and Roth, 1983). Secondly, IgY is transported to the embryonic circulation of offspring through egg yolk. The rate of transfer of IgY starts slowly at 7th day of embryonic life and then gradually increases by 14th day to continue at high rate up to 19th - 21st day of embryo's age (Kowalczyk et al., 1985). The amount of IgY transported to the egg yolk is directly proportional to the maternal serum IgY concentrations, (Al-Natour et al., 2004). Hence, there is genetic variation among different breeds regarding level of serum IgY in hens and then in the level of IgY transmitted to their chicks through egg yolk (Carlander, 2002). So, the purpose of this study is to investigate the level of IgY in hens serum, in egg yolk and serum of newly hatched chicks of four different local developed Egyptian breeds namely Matrouh strain resulting from cross reproduction between White Leghorn and Dokki 4, Silver Montazah was created by crossing between Rhode Island × Dokki 4, Mandarah strain resulted by crossing between Alexandria × Dokki 4 and Inshas strain that reproduced by crossing between Sinai × White Plymouth Rock breeds. The concentration of total serum IgY in the chicken can be genetic indicative of the chicken's fitness and health. Here we measured the concentration of total IgY levels of chicken and analyzed the correlation among the total IgY levels in hen serum and yolk, and offspring serum in four chicken breeds. The results provide an important index for selection of breed having high level of IgY in its serum when the fitness of newly hatched chicks is a concern. This will contribute to the selection of hens having higher antigen-specific IgY to formulate strategies for protecting chicks, especially during the first few days of age when their immune system is not fully functional.

MATERIALS AND METHODS

This experiment was done at the Inshas Poultry Research Station, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt using mixed four local improved Egyptian strains that were Matrouh, Silver Montazah, Mandarah and Inshas. 18 weeks of age thirty six hens and nine cocks of each strain were used. All hens and cocks were hatched on the same day and they were reared under the same environmental conditions. Also, they had similarly vaccinated against diseases. At age of sexual maturity, hens and cocks per each strain were divided into nine families, where each family contained four hens and one sire assigned at random. The artificial insemination was used as a mating system for reproducing the next generation. Fertile eggs were collected two times a day and numbered according to their dams. The fertile eggs were incubated in a forced draft incubator at 99.5°F (37.5°C) with relative humidity of 65%. Then the eggs were transferred to a separate hatcher at 98.5°F and 57% relative humidity. On the day of hatching, chicks were wing banded according to their dams, weighed and moved to brooding house.

Collection of blood samples from hens and offspring:1) At 34 weeks of age 2 ml blood samples was collected in dry tube via the wing vein of hens. The blood samples were centrifuged at 3000 Rpm for 10 minutes at 4°C. The blood was allowed to clot and stored at serum (Siegel and Gross, 1980). 2) At 4^{th} day post-hatch, the chicks were bled via the jugular vein using 0. 5 ml Insulin syringe with 28-gauge needle and serum was collected as described above.

Extraction of egg yolk Immunoglobulin (IgY): Fresh egg laid from each hen were collected one week before blood sample withdrawal from hens. IgY was separated following procedures of Polson (1990) where the yolk was taken out of egg shell. The egg yolk membrane was washed away with distilled water and then the yolk was broken with forceps. The yolk was put into measuring cylinder and mixed with phosphate buffer saline (PBS) that was shaken carefully with yolk, chloroform was added to the tube with volume equal to that of yolk and PBS. Thick emulsion was produced by vigorous mixing of the tube contents. Then the emulsion was centrifuged at 1000 Rpm for 30 minutes at room temperature to separate the emulsion into three distinct layers that were an orange colored solution of lecithin at the bottom, semisolid emulsion yolk in chloroform in the middle and watery one containing IgY on the top. The watery layer was separated and stored at -20°C until analysis. To calculate IgY concentration in each egg yolk the following formula was used:

IgY concentration In whole egg yolk (mg/egg) = egg yolk volume × IgY concentration In yolk

Determination of total IgY concentration in blood serum and egg yolk: Mono reagent, Ams SPA Analyzer medical (Ref. GD 84820) was used for determination of IgY in blood sera of both hens and chicks as well as in the egg yolk. A 20 ml specific for IgY using AMS sat 450 system imported from England to record IgY concentration as mg/ml.

Statistical analysis: Least square means and their standard errors (X ±SE) for this studied trait were calculated for each strain. Data obtained were statistically analyzed using SAS (1988), probability values ≤ 5% were considered for significant. All percentages data were converted to the corresponding arcsine prior statistical analysis. Duncan multiple range test was used for the multiple comparisons of means (Duncan, 1955). The statistical model used in the present study was as follows:

$$Y_{ik} = \mu + S_i + e_{ik}$$

Where: Y_{ik} = The Ith observation of the individual over all means. μ = The common mean. S_i = The fixed effect of ith strains. e_{ik} = Experimental error.

In addition, simple correlation coefficients among IgY concentrations in hens blood serum, egg yolk and chicks blood serum were calculated using the following equation (Snedecor and Cochran, 1986).

$$rx_1x_2 = \frac{\Sigma x_1x_2 - \frac{(\Sigma x_1)(\Sigma x_2)}{n}}{\sqrt{\left[\Sigma x_1{}^2 - \frac{(\Sigma x_1)^2}{n}\right]} * \sqrt{\left[\Sigma x_2{}^2 - \frac{(\Sigma x_2)^2}{n}\right]}}$$

The values of rx_1x_2, rx_1x_3 and rx_2x_3 were calculated where: x_1 = The IgY concentration in hen blood serum. x_2 = The IgY concentration in egg yolk. x_3 = The IgY concentration in chick blood serum. Also, percent of maternal antibody (IgY) transfer was calculated using the following equations:

$$\text{IgY transfer from hen to egg yolk (\%)} = \frac{\text{IgY level in egg yolk}}{\text{IgY level in hen}} \times 100$$

$$\text{IgY transfer from egg yolk to chick (\%)} = \frac{\text{IgY level in chick}}{\text{IgY level in egg yolk}} \times 100$$

$$\text{IgY transfer from hen to chick (\%)} = \frac{\text{IgY level in chick}}{\text{IgY level in hen}} \times 100$$

RESULTS AND DISCUSSION

Effects of chicken strains on IgY antibody concentration: The effects of chicken strains on IgY antibody concentration (X ±SE) in hens blood serum, egg yolk and chicks blood serum (mg/ml) in four local strains of chicken (Mandarah, Matruoh, Silver Montazah and Inshas) are given in Table (1 and Fig. 1). The average of IgY concentration in Mandarah, Matruoh, silver Montazah and Inshas strains (X ±SE) were 4.58 ±1.65, 4.11 ±1.07, 4.08 ±1.47 and 3.44 ±1.64 (mg/ml) in hens blood serum, 3.99 ±0.69, 3.36 ±0.48, 3.30 ±0.31 and 2.67 ±0.48 (mg/ml) in egg yolk and 3.08 ±0.40, 2.53 ±0.38, 2.46 ±0.38 and 1.81 ±0.40 in newly hatched chicks blood serum, respectively. Also, Mandarah strain had higher significant (P<0.001) egg yolk total concentration of IgY 46.59 ±0.986 mg/egg than other strains where that of Matrouh 39.17 ±0.975, Silver Montazah 38.01 ±0.89 and Inshas 29.65 ±0.86 mg/egg respectively (Table 1). Mandarah strain hens had high significant (P≤0.05) concentration of IgY compared to other strains, while Matrouh and Silver Montazah strains expressed no significant differences. On the other hand, Inshas strain had the lowest concentration (P≤0.05) relative to other studied strains. Since the concentration of IgY that transferred to egg yolk and newly hatched chicks is directly proportional to the IgY quantity in serum of hens (Al-Natour et al., 2004), so the results of IgY concentration in either egg yolk or offspring was the greatest for Mandarah strain followed by both Matrouh and Silver Montazah strains that showed no significant differences in level of IgY that was the lowest in Inshas strain. This meant that the IgY level in both egg yolk and the chicks followed the same criterion of maternal antibodies of their hens in different strains. Similar results were reported by Carlander (2002) who reported that there are significant differences among genetic lines or breeds. For example, the IgY concentrations reported were 2.2 ±0.4 mg/ml in Single Comb White Leghorn, 2.0 ±0.5 mg/ml in line SLU-1329, and 1.7 ±0.5 mg/ml in Rhode Island Red. Also, it was reported that the average IgY concentration in the dams serum and egg yolk in two meat line chickens was ranged from 3.26 to 6.02 mg/ml in dams serum and from 1.15 to 2.26 mg/ml in egg yolk (Hamal et al., 2006). They also calculated that the total egg yolk IgY concentration was ranged from 22.5 to 43.9 mg/egg. Recently, Ritu et al., (2016) compared the immunoglobulin Y (IgY) level in laying hens of four different breeds of local chickens. They reported that IgY concentrations ranged from 3.35 ±0.63 to 5.83 ±0.65, 2.30 ±0.10 to 2.60 ±0.20 and 1.30 ±0.11 to 1.70 ±0.16 mg/ml in hens, egg yolk and chicks, respectively.

2. Effect of chicken strains on IgY antibody transferred: Also, the results of Table (1) were confirmed by that of Table (2) and Figure (2) that demonstrated the percentages of IgY transfer from hens to egg yolk in four strains of chickens, Where The average percentages of IgY transferred in Mandarah 87.11, Matrouh 81.75, Silver Montazah 80.88 and Inshas 77.61%. The percentage of transfer of egg yolk to chicks were in sequence Mandarah 77.19, Matrouh 75.29, Silver Montazah 74.54 and Inshas 67.79%. The transfer percentages from laying hens to chicks were Mandarah 67.24, Matrouh 61.53, Silver Montazah 60.14 and Inshas 52.61%, respectively. So the IgY transfer percentage from dams to egg yolk, from egg yolk to chicks and from hens to their offspring were significantly ($P \leq 0.05$) high for Mandarah strain and significantly low ($P \leq 0.05$) for Inshas strain. The present results are in good agreement with the findings of Hamal et al., (2006). They measured the IgY levels in dams blood serum, egg yolk and newly hatched chicks in two meat lines of chickens. They also concluded that the IgY levels in dams blood serum, egg yolk and newly hatched chickens had direct indicator of maternal antibody (IgY) transferred to the circulation of the chicks, with an expected percentages transfer of approximately 30%. Similar results were recently reported by Ritu et al., (2016), who studied the transfer of IgY from the parent layers to egg yolk and then to chicks. They found statistical significant differences among four local breeds of chickens. The transfer percentages were in range of 66.39 ±1.42 to 74.92 ±5.30 (%) from parent layers to egg yolk, 54.99 ±1.93 to 66.52 ±1.99 (%) from egg yolk to chicks and 25.62 ±1.42 to 36.06 ±4.34 (%) from parent layers to chicks. Our results could also be confirmed by experiments of artificial selection for immune response that demonstrated the genetic basis for maternal antibody transfer (Grindstaff et al., 2003). Moreover, Carlander (2002) and Sun et al., (2013) reported that hens having genetically good immune response were able to transfer highly able immune defense to their eggs and consequently valid passive immunity to their chicks. Mandarah strain expressed the highest level of IgY in hens, egg yolk and newly hatch chicks, this is due to the origin of its grandparents that are local Fayoumi strain having high immune resistance against many infections of poultry for example La-sota NDV (Zhang et al., 2018). Also, Hassan et al., (2004) found that Mandarah strain had higher genetic resistance to very virulent IBV and NDV than that of Gimmizah strain and Dandarwi strains.

3. Simple correlation coefficients among the IgY concentrations in layers blood serum, egg yolk and chicks: The correlation coefficients of IgY transferred from the layers to egg yolk and then to newly hatched chicks were calculated. A total of 36 layers with their eggs (36 eggs) and their newly hatched chicks (36 chicks) of four local strains of chickens were taken at random to calculate the simple correlation coefficients among the IgY concentration in layers blood serum, egg yolk and newly hatched chicks (Table 3 and Figs. 3, 4 and 5). The present results explained that there were positive statistical significant simple correlation coefficient between IgY concentration in the layers (X_1) and egg yolk (X_2), between the layers (X_1) and chicks (X_3), and between the egg yolk (X_2) and chicks (X_3) in Mandarah, Matruoh, Silver Montazah and Inshas strains of chicken. As the values of (r x_1 x_2) were 0.854, 0.660, 0.653 and 0.599 (Fig. 3a,3b,3c,3d), also r x_2 x_3 correlation results recorded 0.641, 0.495, 0.472 and 0.398 (Fig. 4a,4b,4c,4d) lastly the r x_1 x_3 correlations were 0.570, 0.390, 0.351 and 0.230 (Fig. 5a,5b,5c,5d)for Mandarah, Matruoh, Silver Montazah and Inshas strains of chicken by sequence for all previous correlations that were significant for all the studied four breeds. However Mandarah strain had the highest positive significant correlations compared to other tested strains. Similar results were reported by Sun et al., (2013), who studied the correlation between the levels of total serum IgY and egg yolk in three different breeds. They found that there were significantly positive correlations between the levels of total serum IgY and total yolk IgY in all three breeds (White Leghorn, r = 0.404, P≤0.001, Silki breed, r = 0.561, P≤0.001 and Dongxiang blue-shell, r = 0.619, P≤0.001). They also found the same tendency among hen serum IgY, egg yolk IgY and offspring serum IgY. The IgY level in 3-day hatched chicks serum was significantly positive correlated with hen serum IgY (r = 0.535, P = 0.001) and with egg yolk IgY (r = 0.481, P = 0.001). The results of our study confirmed that the layers with higher IgY levels may in turn lay eggs with higher IgY levels which suggests that hens of good immune state were able to allocate more immune defense ability to eggs and their offspring.

CONCLUSION

The results of this study showed that the concentration and percentages of IgY transferred from dams of Mandarah strain to both egg yolk and their chicks was significantly high relative to other strains. On the other hand, Inshas dams transferred the lowest concentration and percentage of IgY to both egg yolk and chicks compared to other strains. So the strains having already high immune response (Mandarah strain) will automatically transfer high level of IgY to either egg yolk or chicks, while that having low immune response (Inshas strain) will subsequently transmit low concentration of IgY to either egg yolk or chicks. This conclusion was confirmed by significant positive values of correlation between IgY of dams and that of egg yolk as well as the correlation between IgY of egg yolk and that of chicks. Also, there was significant correlation between IgY of dams and their chicks. So, IgY antibody concentrations could be used as immunogenetic index for selection between and\or within strains to improve immune qualities of chicken. Also, IgY could be used as immunoassay determining the immune fitness of egg yolk and consequently the newly hatched chicks of different chicken strains. This is very important for poultry industry, as the level of IgY could be an Index for immune resistance of chicks to many poultry infections (for example NDV and IBV). Also the time table of vaccines may be established on basis of IgY concentration and its life cycle.

Table (1): Effect of chicken strains on IgY concentration (X ±SE) in hens, egg yolk and chicks in four local strains of chickens.

Traits	Igy concentration (X ±SE)			
	Mandarah	**Matrouh**	**Silver Montazah**	**Inshas**
Hen serum (mg/ml)	4.58 [a] ±1.65	4.11 [b] ±1.07	4.08 [b] ±1.47	3.44 [c] ±1.64
Egg yolk (mg/ml)	3.99 [a] ±0.69	3.36 [b] ±0.48	3.30 [b] ±0.31	2.67 [c] ±0.48
Egg yolktotal(mg/ml)	46.59 [a]±0.986	39.17 [b] ±0.975	38.01 [b] ±0.892	29.65 [c] ±0.864
Chick serum(mg/ml)	3.08 [a] ±0.40	2.53 [b] ±0.38	2.46 [b] ±0.38	1.81 [c] ±0.40

[a, b, c, …] Means within the same row with different superscripts are significantly different ($P \leq 0.05$).

Table (2): Effect of chicken strains on IgY transferred (%) from dams to egg yolk and chicks in four local strains of chickens.

Traits	**IgY level (mg/ml)**	**Transferred (%)**
	Mandarah strain	
Dams to egg yolk	4.58 ±1.67	87.11
Egg yolk to chicks	3.99 ±0.67	77.19
Dams to chicks	3.08 ±0.42	67.24
	Matrouh strain	
Dams to egg yolk	4.11 ±1.07	81.75
Egg yolk to chicks	3.36 ±0.42	75.29
Dams to chicks	2.53 ±0.20	61.53
	Silver Montazah strain	
Dams to egg yolk	4.08 ±1.47	80.88
Egg yolk to chicks	3.30 ±0.31	74.54
Dams to chicks	2.46 ±0.35	60.14
	Inshas strain	
Dams to egg yolk	3.44 ±0.68	77.61
Egg yolk to chicks	2.67 ±0.10	67.79
Dams to chicks	1.81 ±0.21	52.61

Table (3): Correlation coefficients (r) of IgY levels among hen blood serum (X_1) egg yolk (X_2) and chicks blood serum (X_3) in four local strains of chickens.

Source of variation	**Mandarah strain**	**Matrouh strain**	**Silver Montazah strain**	**Inshas strain**
X_1 X_2	0.854**	0.660**	0.653**	0.599**
X_2 X_3	0.641**	0.495**	0.472 *	0.398 *
X_1 X_3	0.570**	0.390 *	0.351 *	0.230*

* = Correlation is Significant and ** = Correlation is Highly Significant ($P < 0.001$)X_1 = Dams, X_2 = egg yolk, X_3 = chicks n = 36

Fig. 1: Effect of chicken strains on IgY concentration in hens, egg yolk and chicks in four local strains of chickens.

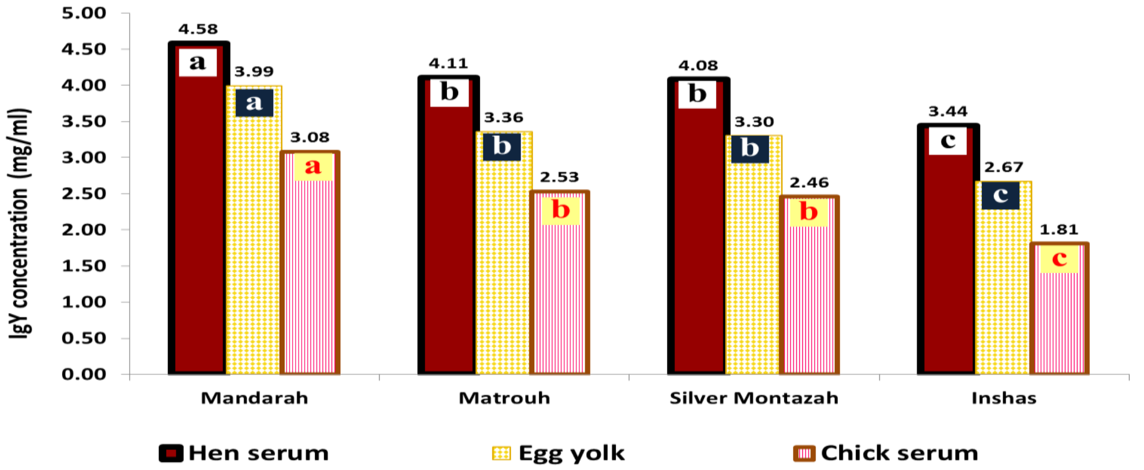
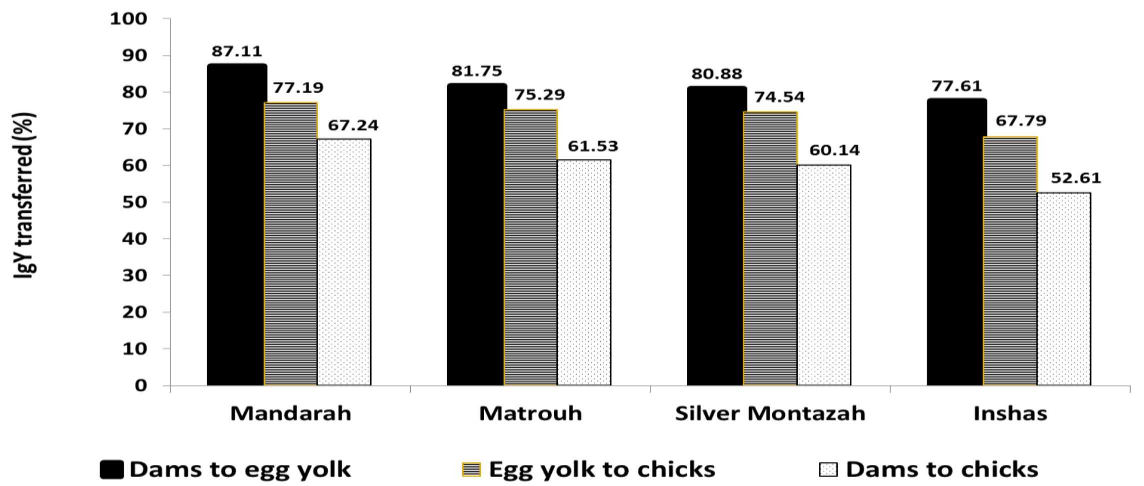


Fig. 2: Effect of chicken strains on IgY transferred (%) from dams to egg yolk and chicks in four local strains of chickens.



Hen - egg yolk – chick – IgY- correlation.

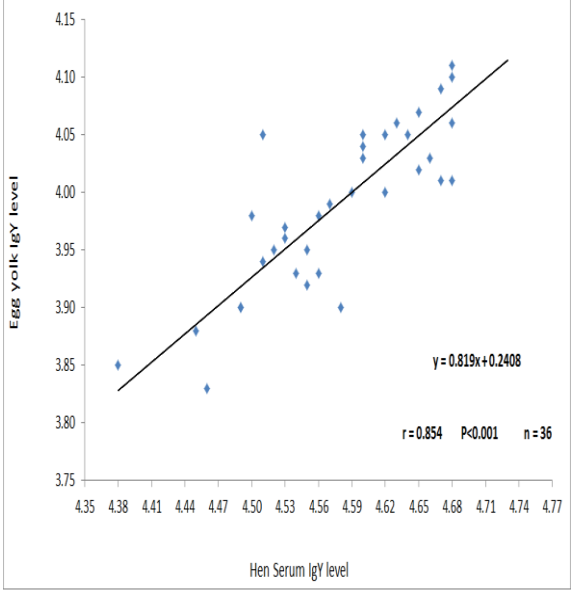


Fig. (3-a): Correlation coefficients of IgY levels among hen serum IgY and egg yolk IgY levels in Mandara chicken.

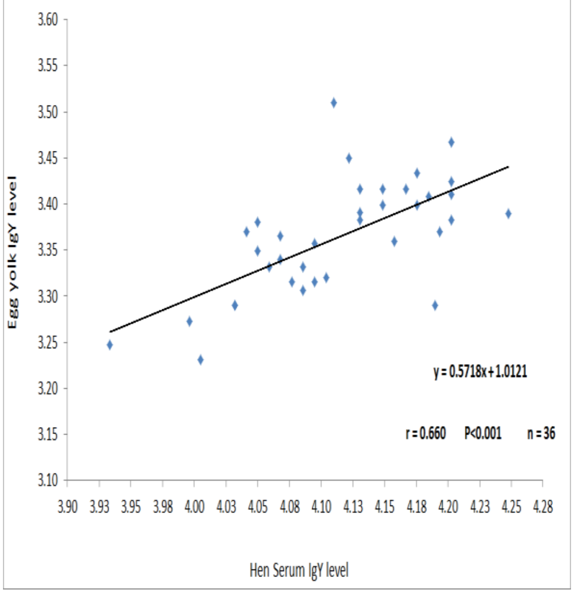


Fig. (3-b): Correlation coefficients of IgY levels among hen serum IgY and egg yolk IgY levels in Matrouh chicken.

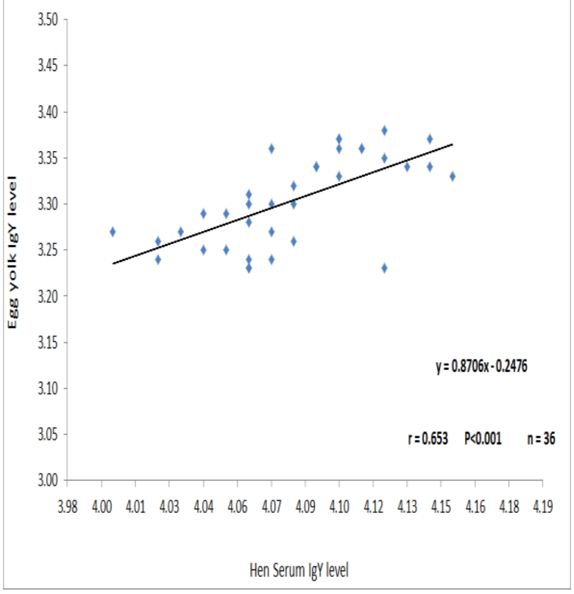


Fig. (3-c): Correlation coefficients of IgY levels among hen serum IgY and egg yolk IgY levels in Silver Montazah chicken.

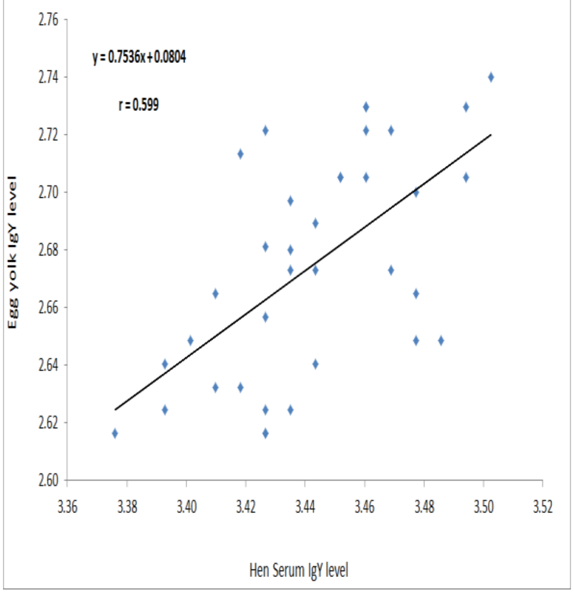


Fig. (3-d): Correlation coefficients of IgY levels among hen serum IgY and egg yolk IgY levels in Inshas chicken.

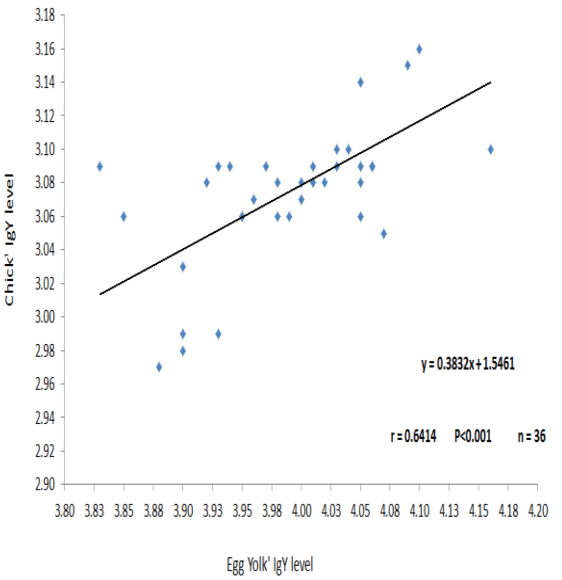


Fig. (4-a): Correlation coefficients of IgY levels among egg yolk IgY level and chick IgY level in Mandara chicken.

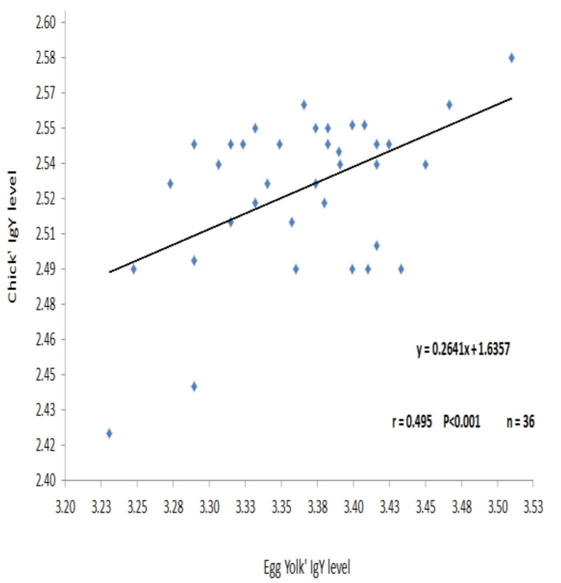


Fig. (4-b): Correlation coefficients of IgY levels among egg yolk IgY level and chick IgY level in Matrouh chicken.

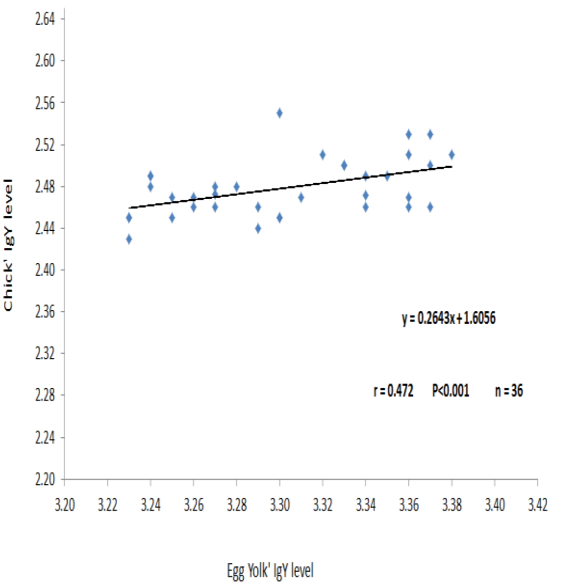


Fig. (4-c): Correlation coefficients of IgY levels among egg yolk IgY level and chick IgY level in Silver Montazah chicken.

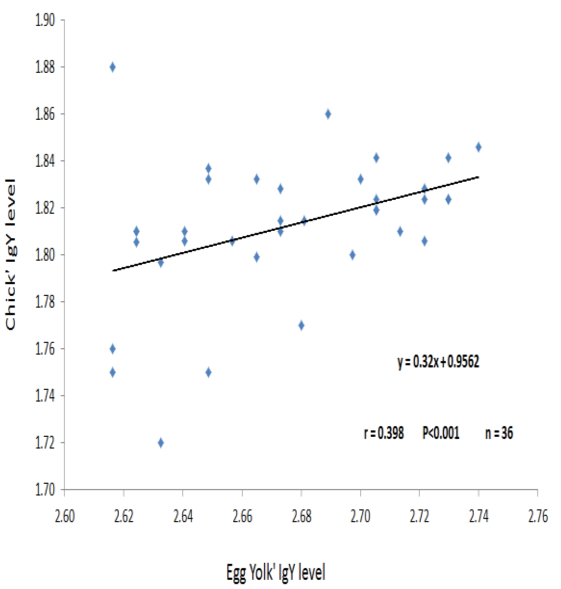


Fig. (4-d): Correlation coefficients of IgY levels among egg yolk IgY level and chick IgY level in Inshas chicken.

Hen - egg yolk – chick – IgY- correlation.

Fig. (5-a): Correlation coefficients of IgY levels among hen serum IgY and chick IgY levels in Mandara chicken.

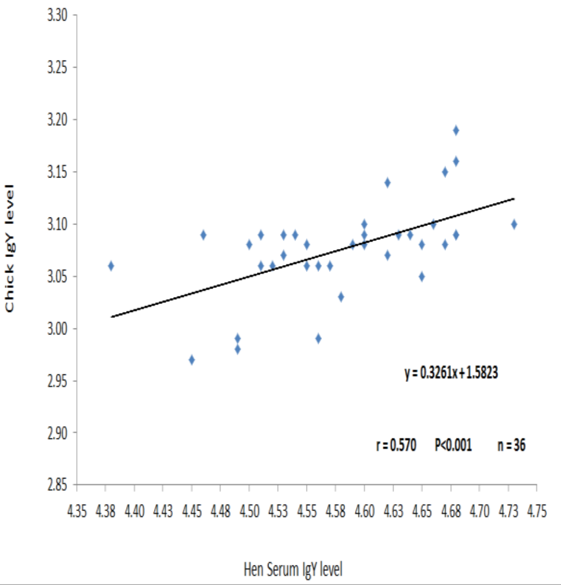


Fig. (5-b): Correlation coefficients of IgY levels among hen serum IgY and chick IgY levels in Matrouh chicken.

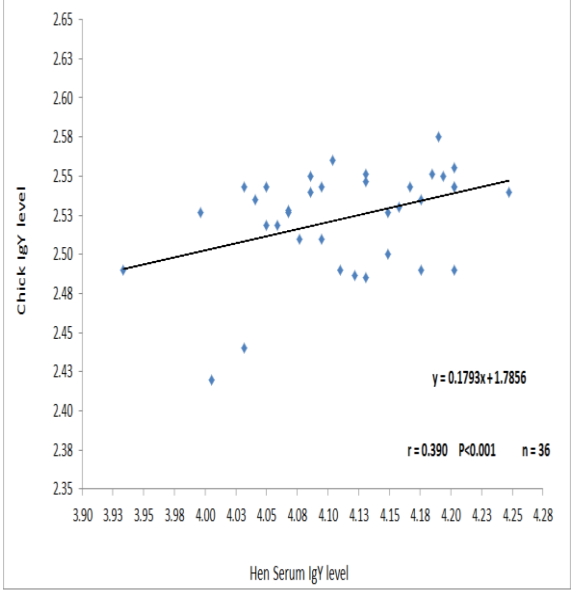


Fig. (5-c): Correlation coefficients of IgY levels among hen serum IgY and chick IgY levels in Silver Montazah chicken.

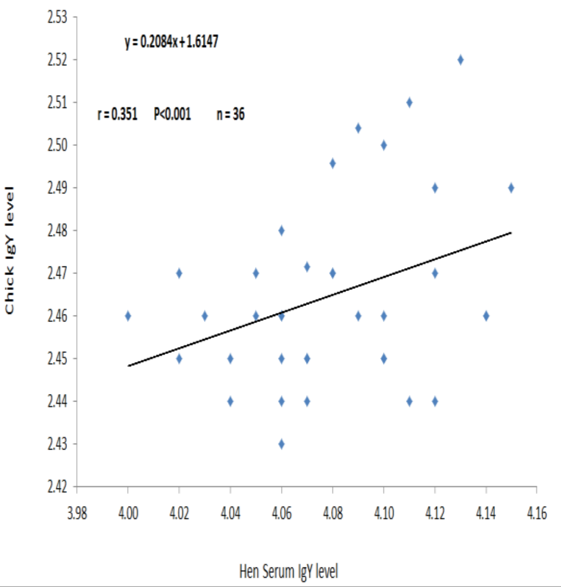
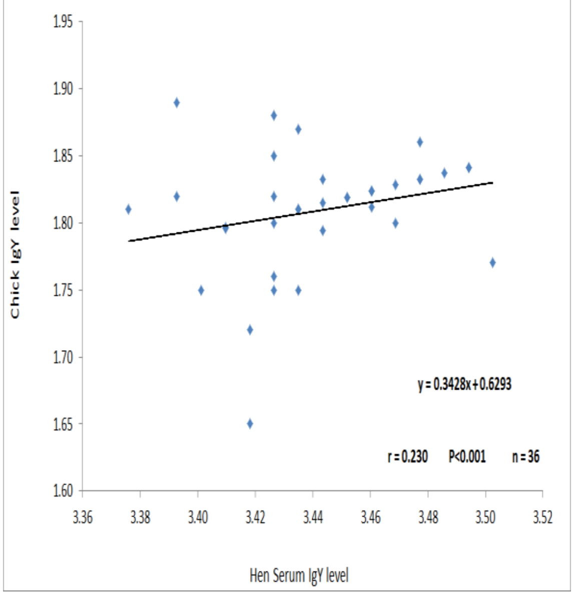


Fig. (5-d): Correlation coefficients of IgY levels among hen serum IgY and chick IgY levels in Inshas chicken.



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الملخص العربى

انتقال الامينوجلوبيولين Y من الامهات الي صفار البيض والكتاكيت لبعض السلالات المصرية المحسنة.

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أجريت هذه الدراسة لتقييم الكفاءة المناعية للكتاكيت حديثة الفقس لأربعة سلالات دجاج مصرية مستنبطة وذلك عن طريق قياس المناعة الأمية (IgY antibody) والذى ينتقل من الأمهات إلى الكتاكيت من خلال صفار البيض. - السلالات المستخدمة هى (المندرة – مطروح – المنتزه الفضى – أنشاص)- تم استخدام عدد 36 أم (عمر 18 أسبوع) من كل سلالة. - تم قياس تركيز الـ (IgY antibody) فى سيرم الأمهات وكذلك الكتاكيت حديثة الفقس، كما تم فصل صفار البيض لتحديد مستوى (IgY antibody) فى صفار البيض. وقد أوضحت النتائج أن:- سلالة المندرة كانت الأعلى معنويا فى تركيز الـ (IgY antibody) فى الامهات والذى انتقل إلى صفار البيض ومنه إلى الكتاكيت حديثة الفقس، ثم سلالة مطروح وسلالة المنتزه الفضى ولم يكن هناك فرق معنوى بينهم. ويلى ذلك سلالة انشاص والتى كانت أقلهم معنويا فى تركيز الـ (IgY antibody). - كان هناك ارتباط موجب بين تركيز المناعة الأمية الـ (IgY antibody) فى الامهات البياضة وصفار البيض ، وبين الدجاج البياض والكتاكيت، وبين صفار البيض والكتاكيت فى الأربعة سلالات. - كان هناك ارتباط معنوى موجب بين مستوى تركيز الأجسام المناعية الكلية فى السيرم والمستوى الكلى للأجسام المناعية الكلية فى صفار البيض فى الأربعة سلالات ومع ذلك كانت سلالة المندرة لها الارتباط الأعلى موضحا أن كتاكيت المندرة يجب أن لها مستوى أعلى من المناعة الأمية ضد الأمراض المعدية خلال المرحلة المبكرة من العمر. - لوحظ ان الامهات البياضة عالية المناعة وضعت بيض ذو مناعة امية عالية ويتوقع ان الامهات جيدة المناعة تكون قادرة لتحقيق قابلية دفاع قوية للبيض والابناء. - توضح النتائج الحالية ان تركيز المناعة الامية (IgY antibody) يمكن استخدامه كدليل وراثي لتحسين بعض الصفات المناعية في الدجاج وذلك لوجود ارتباط موجب بين التركيز الكلي (IgY antibody) والحالة الصحية للدجاج.