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## The Relationship between egg production and immune response in Breeders and their progeny Reared under Field Conditions

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### ABSTRACT

Immune system function is directly influenced by physiological status, as well as by many other factors. The objective of the current study was to evaluate the relationship between egg production and humoral antibody titers in breeder hens and further with the passive immunity of their egg yolk and progeny under Field Conditions. One vaccination schedule was followed for 15779 Ross-308 broiler breeders, divided into three replicates in 3 floor pens of the same farm through period of July 2010 to March 2011 . A total of 585 serum samples of the dame, 360 of hatched chicks and 360 egg yolk samples were obtained through the study period. Anti-Newcastle disease virus (NDV) and anti-infectious bursal disease (IBDV) antibody titers were evaluated using ELISA. The results revealed that there was a significant correlation ( $P < 0.01$ ) between egg production rates and mean of NDV anti body titers of hens' sera, chicks sera and extracted egg yolk with a correlation coefficients of  $r = 0.42$  ,  $0.55$  and  $0.76$  respectively. Also correlation between egg production rates and mean of IBDV anti body titers of extracted egg yolk was significant ( $P < 0.01$ ) with correlation coefficients of  $r = 0.44$ , but no correlation was found with chicks sera ( $r = 0.025$ ) and was in negative direction with breeders' sera ( $r = -0.33$ ). The maternal antibody transferred to yolk and chicks' sera were 81% and 83% in yolks, 73% and 81% in chicks and 91% and 97% from yolk to chicks for NDV and IBDV respectively. It has been concluded that, there is a significant correlation between egg production and humoral immune response in broiler breeders and antibody titers transmitted to their yolks and progeny under field conditions and recommended that more studies under field conditions with different vaccination schemes is require.

**Keywords:** breeders, egg production, immune response, correlation, NDV, IBDV.

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## INTRODUCTION

NDV infections still continue to be one of the major virological causes of drops in egg production and quality (**Bouma *et al.*, 2008**). Infectious bursal disease (IBD) occurs worldwide (**Lukert and Saif, 1997**) Creating epizootic status is an important measure in commercial poultry, particularly in breeding flocks, because of the need to perform preventive strategy. Vaccination is a critical control measure for many infectious diseases of poultry, many areas of the world have found maternal antibodies a very useful tool in IBD prevention and control (**Bermudez 2003**). passive immunity successful in chicks, depends upon adequate vaccination and antibody titer of the breeder hens. Within reason, the higher titer (measure of circulating antibodies) in the hen, the greater the transfer to the chick (**Ieelson and Summer , 2009**). A contrary relationship between egg drop and HI antibody titre had been found against challenge by pathogenic NDV. The HI titre required to protect against mortality induced by NDV is about 5 log<sub>2</sub>, while the titre required to protect against the egg drop is 9 log<sub>2</sub> (**Allan *et al.*, 1978 Saravanabava *et al.*, 2005 and Raghul *et al.*, 2006**). The transmission studies indicate that vaccinated birds with low or undetectable antibody titres may be protected against disease and

mortality but that infection and transmission may still occur (**Bouma *et al.*, 2008**) which result in direct damage of the reproductive tract leading to decrease in egg production. Furthermore, the number of Ig-positive cells in the ovarian stromal tissue increases as chickens mature and decreases with ageing, and that oestrogen may be involved in this process (**Barua, *et al.*, 1998**). Therefore, the effect of NDV on egg production and quality is as a result of direct damage of the reproductive tract rather than physiological stress on the bird (**Sreenivasa *et al.*, 2002**). Maternal protein reserves may be catabolized to support egg production and antibody formation and nutritional resources expended on immune function may induce trade-offs with other energetically expensive functions, including reproduction. Therefore, the immune system can serve as a sensitive indicator of management and production influences on avian health (**Qureshi *et al.*, 1998**). Regular Serological monitoring is conducted to determine the immune status of flocks and maternal antibody level in chicks. It also helps to regulate poultry breeding and improve the quantity and quality of the production. The objective of the current study was to evaluate the relationship between egg production and humoral antibody titers in breeder hens and further with the passive immunity of

their egg yolk and progeny under Field Conditions

## MATERIALS AND METHOD

This study was conducted on commercial flock of 15779 (Ross 308) broiler breeders at Jahran district, Dhamar, Yemen. divided and kept at three pens as three replicates of the same farm, owned for one producer, reared under good management and hygienic measures and were fed a commercial balanced breeders' diet. The birds submitted to similar management processing, feeding and ambient conditions. One vaccination schedule was followed as shown in table (1)

A total of 585 serum samples of the dame, 360 egg yolk samples and 360 serum samples of hatched chicks had been collected from the three replicates at 8 occasions throughout the study period, with approximately 4 – 6 weeks interval in 32 weeks, started from the 28<sup>th</sup> week of chicken age and ended on the 60<sup>th</sup> week of parent age. In all occasions, blood had been taken from wing or jugular vein for serum preparation. After 5 days of bleeding, eggs for both yolk extraction and hatching had been taken from each pen (table 2) (egg and sera were not collected from the same bird).

**Table 1:** vaccination schedule against NDV & IBD for studied broiler breeders among

Age /week	Age /day	Type of vaccine	Administration method
1	2-3	HB1+H120	Eye drop
1	4	ND oil emulsified	S/C injection
2	13	Gumboro D78+VK3+	Drinking water
3	22	Gumboro D78+VK3+	Drinking water
4	24	IB Brimer +ND W	Drinking water
6	37	ND LsSota	Drinking water
7	45	oil emulsified ND +Salmonella 9R	IM injection
10	65	ND LsSota	Drinking water
16	115	IB +ND	Drinking water
20	140	Reo+IBD+ND+IB	IM injection
21	147	ND	Drinking water
46	322	Gumboro D78+VK3+	Drinking water

8	60 <sup>th</sup> week	70	45	45
<b>total</b>		<b>585</b>	<b>360</b>	<b>360</b>

Yolks were extracted according to Biochek<sup>®</sup> yolk extraction / dilution procedures.

The sera of day-old chicks have been sampled within 8–12 hours after hatching. The chicks were sacrificed and blood was directly collected into test tube.

Sera and extracted egg yolks stored in sterile 1.5 ml Eppendorf's tubes, heat inactivated at 56°C for 30 minutes in water bath and kept at 20°C until examination. Anti-NDV and IBDV antibody titers were evaluated using ELISA. The data of egg production rates were collected from the farm records and analyzed.

**Table 2:** number, type and timing of samples obtained from the 3 breeders' pens among study period.

Sampling number	Age of breeders	Sample type & number		
		Blood from breeders	eggs for yolk extraction	Blood From hatched chicks
1	28 <sup>th</sup> week	75	45	45
2	32 <sup>th</sup> week	75	45	45
3	38 <sup>rd</sup> week	75	45	45
4	42 <sup>nd</sup> week	75	45	45
5	46 <sup>th</sup> week	75	45	45
6	50 <sup>th</sup> week	70	45	45
7	56 <sup>th</sup> week	75	45	45

All ELISA assays were performed in the Serological Unit, according to the manufacturer's standard protocol

The commercial available NDV and IBDV antibody test kits were used, NDV plus ELISA kits, produced by Biochek<sup>®</sup> Corporation,

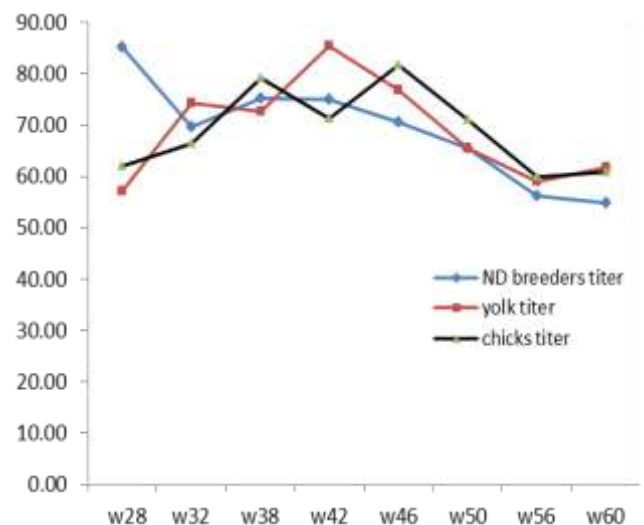
Endpoint titers were determined using the forecast method in EXCEL and The data were analyzed using the computer (SPSS version 14 ) program. Analysis of Variance (ANOVA) was used for statistical significance and personal correlation analysis for correlations, the Correlation significant were calculated at the 0.01 or 0.05 levels (2-tailed). Differences between means were considered significant at P<0.01 or P<0.05.

## RESULTS AND DISCUSSION:

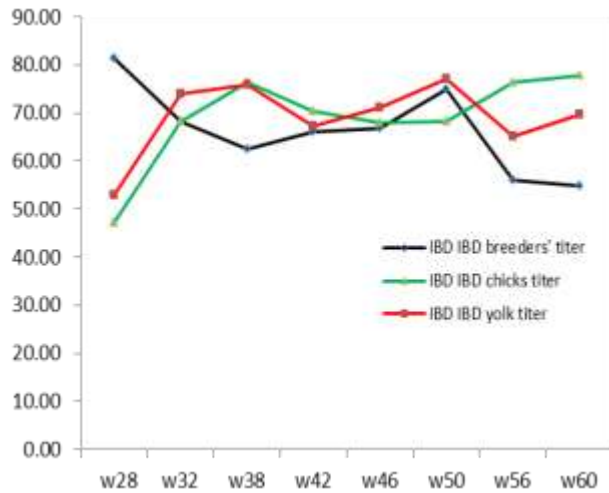
The mean titers produced throughout the experimental period in the three types are shown in figure 1. The ND antibody titers increased at the 28<sup>th</sup> week of age and reached its peak, this may be due to the fact that the inactivated vaccine provided a high, homogeneous, and durable serologic response in breeders (Facon *et al.*, 2005). compared to those of their yolks and progeny, no significant differences had found ( $P > 0.05$ ), in which the maternal antibodies transferred to yolk and chicks' sera were relatively low as 54% & 53% respectively. At the 32<sup>nd</sup> week, the antibody titers of breeders' sera decreased contrary to those in the egg yolk and chicks and during subsequently period of the study, the titer curves were goes down gradually for the breeders' sera, and the same pattern for yolks and chicks' sera with positive but low correlation coefficient between breeders and their yolks ( $r = 0.27$ ) and chicks ( $r = 0.36$ ), This finding is supported by results obtained by Keck *et al.*, (1993) and Al-khadher (2008), who found that the correlations between a hen's serum titers and their egg yolks and

chicks were low to moderate ( $r = 27- 43$ ). Whereas, there was a positive and high degree of correlation ( $r = 0.68$  in ND and  $r = 0.69$  in IBD) was found between titers of yolks and chicks sera (figure 2.). This nearly similar to results found by Al-khadher (2008), for HI titers of yolks and day-old chicks, with a correlation coefficient of  $r = 0.65$ .

In Previous study (Silim and Venne, 1989), the correlation between breeders and their yolks of IBD antibody titers exposed a high correlation ( $r = 0.9$ ) in contrast to negative correlation recorded in our study ( $r = - 0.32$ ), even though, the correlation between breeders and their chicks was high ( $r = 0.89$ ). This difference is likely to be due to the dissimilarity of extraction method or vaccines and vaccination schedules,



**Fig. 1.** The relationship between means of ND antibody titer in breeders' sera, egg yolk and hatched chicks.

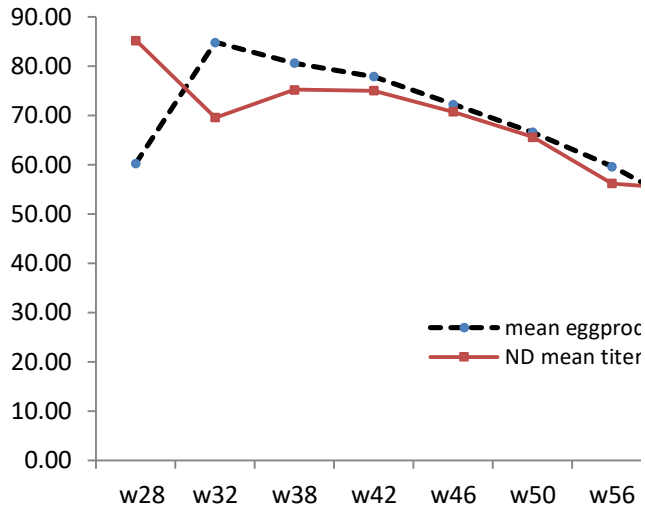


**Fig. 2.** The relationship between means of ND antibody titer in breeders' sera, egg yolk and hatched chicks.

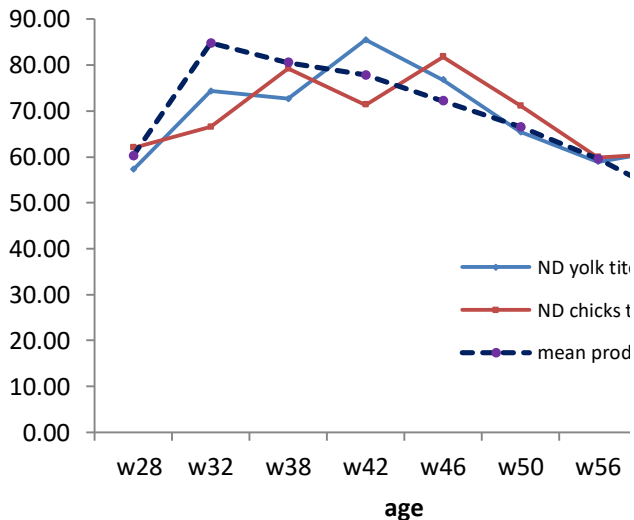
At the period from the 28<sup>th</sup> to the 38<sup>th</sup> week of breeders' age, the correlation between egg production rates and mean of NDV antibody titers of hens' sera was in negative direction with a correlation coefficients of  $r = -0.74$ , at the 0.05 level ( $P < 0.05$ ) whereas, from the 38<sup>th</sup> week, the correlation was in negative direction with a correlation coefficients of  $r = 0.92$  at the 0.01 level ( $P < 0.01$ ). it was attributed to that the titer fell to their lowest level in week 32 coinciding with the physiological sharp increase during peak production period may be due to the fact that the maternal protein including  $\gamma$ -globulin reserves may be catabolized to support egg production (Bunchasak et al.2005), and then,

both titer and egg production inverted to slow down up to the end of study period.

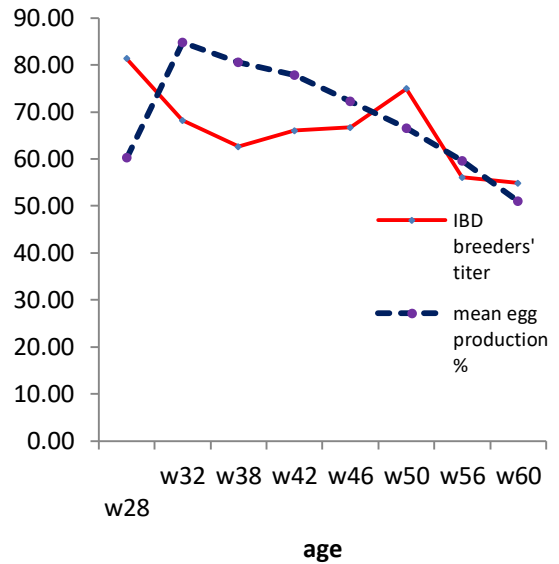
With mean of the total study period, there was a significant correlation at the 0.01 level ( $P < 0.01$ ) between egg production rates and mean of NDV antibody titers of hens' sera (figure 3.), chicks sera and extracted egg yolk (figure 4.) with a correlation coefficients of  $r = 0.42$ ,  $0.55$  and  $0.76$  respectively. Previous studies, (Caldwell et al.,, 1999) reported a positive correlation between immune response against vasoactive intestinal peptide (VIP) and egg production rate in turkey hens. However, in case of IBD (illustrated in figure 5), the correlation was in negative direction ( $r = -0.33$ ). These findings agree with previous results (Shashidhara and Devegowda, 2003) that Found, an improvement in Antibody responses against IBDV and maternal antibody titers in progeny but had no consistent influence on egg production. The reason is likely to be that, the number of Ig-positive cells increases as chickens mature and decreases with ageing, and that oestrogen may be involved in this process (Barua, et al.,, 1998). As seen in figure (6), correlation between egg production rates and mean of IBDV anti body titers of extracted egg yolk was significant ( $P < 0.01$ ) with correlation coefficients of  $r = 0.44$  but no correlation was found with chicks sera ( $r = 0.025$ )



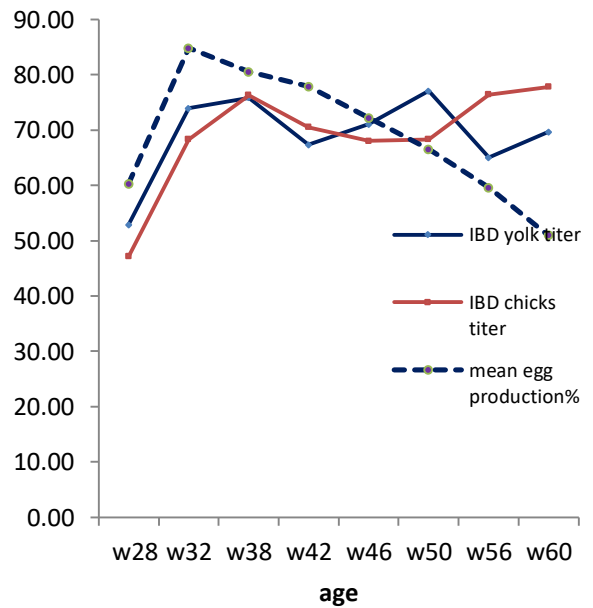
**Fig. 3.** The relationship between the mean of egg production and mean of ND antibody titer in breeders' sera.



**Fig. 4.** Relationship between the mean of egg production and mean of ND antibody titer in egg yolk and chicks.



**Fig. 5.** The relationship between the mean of egg production and mean of IBD antibody titer in breeders' sera.



**Fig. 6.** Relationship between the mean of egg production and mean of IBD antibody titers in eggs yolks

in general, as in previous studies, the present results demonstrated that the antibody titers in egg yolks and chicks were lower than the titer of breeder hens (Rao *et al.*, 1987). In the present study, NDV antibodies transfer rate had ranged between 54% - 91% in yolks, 53% - 84% chicks sera (figure 7) and 76% - 98% from yolk to chicks (figure 8) with mean of 81%, 73% and 91% in yolks, chicks and from yolk to chicks respectively. However, in a previous study, it was 35.5 to 40.7% in 2 different lines of chickens (Hamal *et al.*, 2006) and 29.2% (Gharaibeh, *et al.*, 2008). Also in the IBDV, the maternal antibody transferred had ranged between 53% - 99% in yolks, 46% - 99% chicks sera (figure 9) and 86% - 115% from yolk to chicks (figure 10) with mean of 83%, 81% and 97% in yolks, chicks and from yolk to chicks respectively. Our results also coincide with those reported by Msoffe *et al.*, (2006) whom had seen that the mean HI titres in chicks were significantly higher than those in hens and eggs ( $P < 0.05$ ). In other previous studies ,IBDV antibodies transfer rate was 45% in layers (Fahey *et al.*, 1987) and ranged from 30 to 53% in native Egyptian chickens (Abdel-Moneim and Abdel-Gawad, 2006), but it had the highest ( $P < 0.05$ ) transfer rate of 73.6% among all the

pathogens tested for. (Gharaibeh, *et al.*, 2008). Allan *et al.*, (1978); Gordon and Jordan, (1982) and Loeken and Roth, ( 1983 ) confirmed that the amount of IgY transported is known to be proportional to the maternal serum IgY concentration. The concentration of passively acquired IgG in the serum of the newly hatched chicks are approximates as in the adult values and it can be equated with that of the hen 5 days before the egg was laid.

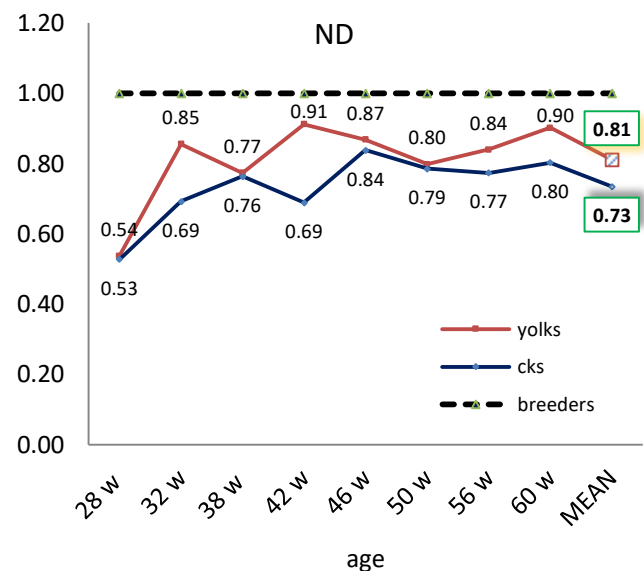


Fig. 7. The percentage of ND maternal antibodies transferred from breeders to their yolks and chicks' sera.



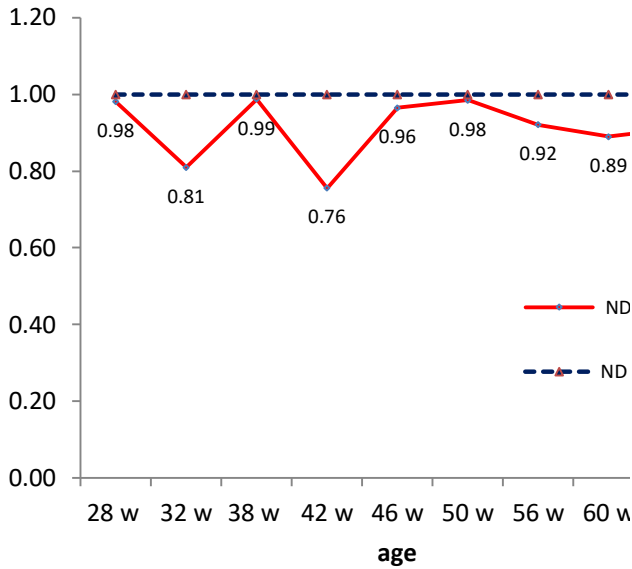


Fig. 8. The percentage of ND maternal antibodies transferred from yolks to chicks' sera.

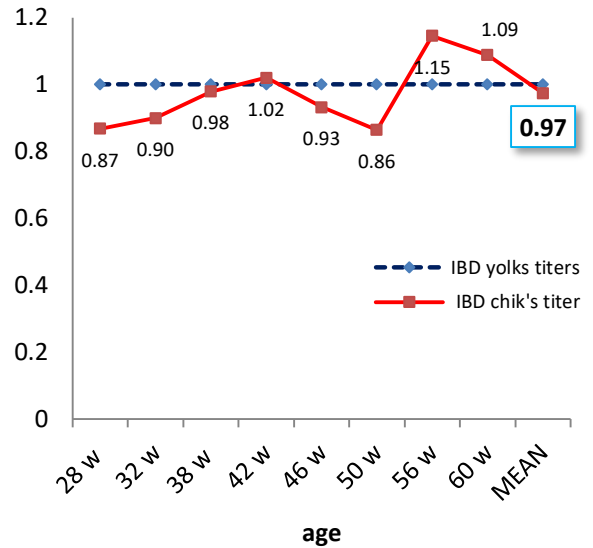


Fig. 10. The percentage of IBD maternal antibodies transferred from yolks to chicks' sera.

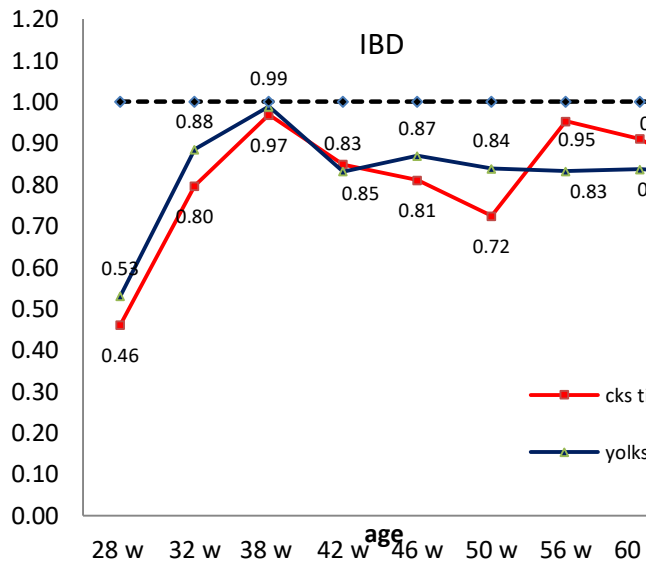


Fig. 9. The percentage of IBD maternal antibody transferred from breeders to their yolks and chicks' sera.

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## العلاقة بين نسب انتاج البيض والاستجاب المناعية للأمهات وأبنائها المربأة تحت الظروف الحقلية.

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### الملخص:

تتأثر وظيفة الجهاز المناعي في الدجاج بالحالة الفسيولوجية وكثير من العوامل الأخرى. صُممت هذه الدراسة بهدف تقييم العلاقة بين مستوى البيض ومعيار المناعة المصلية لدى أمهات الدجاج اللاحم والمناعة الأمية المنتقلة الى مح البيض والأبناء تحت الظروف الحقلية. خضعت 15779 دجاجة أمهات لحم سلالة روص 308 للدراسة ضمن برنامج لقاحي موحد وقسمت في ثلاثة عنابر كمكررات في نفس الحقل. جمعت 585 عينة مصل من الأمهات و360 عينة مح البيض و360 عينة مصل من الكتاكيت الفاقسة استخدمت لمعايرة الأجسام المضادة للقاح النيوكاسل والجامبورو باستخدام اختبار الإليزا. أظهرت النتائج وجود ارتباط معنوي ( $P < 0.01$ ) بين نسب انتاج البيض ومتوسطات معيار الأجسام المضادة للقاح النيوكاسل في مصل الأمهات والمح المستخلص ومصل الكتاكيت الفاقسة بمعامل ارتباط ( $r$ ) مقداره 0.42 و 0.76 و 0.55 على التوالي. كذلك كان الارتباط بين نسب انتاج البيض ومتوسطات معيار الأجسام المضادة للقاح الجامبورو معنوية في المح المستخلص ( $P < 0.01$ ) بمعامل ارتباط  $r = 0.44$  وغير معنوية في مصل الكتاكيت الفاقسة ( $r = 0.025$ ) في حين كان الارتباط بقيمة سالبة مع مصل الأمهات بمعامل ارتباط ( $r = -0.33$ ). كانت نسبة الأجسام المضادة المنتقلة من الأمهات تساوي 81% و 83 % الى مح البيض، و 73% و 81% الى الكتاكيت الفاقسة. وكانت 91% و 97% من مح البيض الى مصل الكتاكيت الفاقسة وذلك للقاح النيوكاسل والجامبورو على التوالي، وقد خلصت هذه الدراسة الى وجود ارتباط معنوي بين نسبة انتاج البيض والإستجابة المناعية المصلية في أمهات الدجاج اللاحم ومعيار الأجسام المضادة في مح البيض ومصل الأبناء تحت الظروف الحقلية ويوصى بمزيد من الدراسات باستخدام لقاحات وبرامج لقاحية مختلفة تحت الظروف الحقلية.