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Comparative Serological Evaluation of The Maternal and Acquired Immunity of Newcastle Disease In chickens

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Abstract

Infectious avian, including Newcastle disease (ND), are a major concern in poultry husbandry. The primary method of preventing viral infections is immunization by vaccines to produce neutralizing antibodies. In the first ten days of life, chicks are protected by maternally derived antibodies (MDA). This study aimed to; evaluate and reveal the strength and importance of maternal immunity against ND in the bird's life and to compare it with the acquired immunity by measurement of antibody titers with Elisa test. Total number of 150-day-old broiler chicks (Ross 308) with a history of vaccination of parent against ND, were reared to achieve the study, serum samples were also taken from vaccinated layers with ND to complete the current study. Commercial Elisa kit was used to determine the titers of antibodies against NDV in broilers and layers. The results showed that the chicks have high levels of maternal antibodies at day old with an average titer of 1287. The levels of maternal antibodies declined over time, and by day 31, the average titer was 90.8 in the unvaccinated group. The vaccinated group had higher levels of antibodies on day 31 (21 days after vaccination), with an average titer of 370.4. However, MDA levels on the first day of life were still higher than the levels of acquired antibodies because MDA interfered with the development of acquired immunity after vaccination. This study concluded that maternal immunity is important for providing early protection against ND, and recommended that the chicks must be tested to measure the antibody levels before vaccination to avoid interference between MDA and acquired antibodies.

Keywords: broiler chicks, antibodies, immunity, vaccine.

Introduction

Newcastle disease (ND) is one of the most common transmissible diseases affecting poultry, it is widespread and can result in significant economic losses for farmers. a paramyxovirus, is the main cause of the disease and is an enveloped, non-segmented, negative-sense RNA virus (1). The primary means of preventing viral infections is immunization with vaccines. (2). The chick is protected by maternal antibodies throughout its early days and develops passive immunity via maternal immunoglobulin Y (IgY) which transport from the egg yolk to serum (3). However, the half-life of maternal antibodies in chickens is quite short; maternal antibodies provide complete protection against the principal contagious viruses in chicks for 10-14 days (4). Active immunization provides continuous protection to chickens. Maternal antibodies, have been demonstrated to interfere with the formation of an effective immune response to vaccines, including suppression of B and T helper cells, antigen processing, and activation of T suppressor cells (5& 6).

Vaccination against ND is usually implemented in most endemic countries worldwide as the main preventing strategy against that disease at various ages of the bird life (7). Although vaccination protocol depends on the endemicity of the disease in a specific area, live vaccines are usually used at the early stages of life up to about 10 weeks of age, where the inactivated vaccines are used as booster (8). ND immunization programs including inactivated and live attenuated vaccines to improve protection against infectious diseases. Live Attenuated vaccines prepared from lentogenic strains of NDV and chemically treated strains, mixed with adjuvant materials (9&10). In fowl, live vaccines are giving by eye drop or drinking water to stimulate defensive local immune response by (IgA) antibodies (11). While inactivated vaccine administrated by injection has been provide high levels of antibodies (humeral immunity) which protect the chicks against ND infection.

The major aim of this study was to evaluate and reveal the strength and importance of maternal immunity in the bird's life and to compare it with the acquired immune response by using the Elisa test.

Materials And Methods

The current study was carried out at the educational Poultry Farm of the College of Veterinary Medicine University of Basrah, as part of the research of the Department of Pathology and Poultry Diseases. Total number of 150-day-old broiler chicks (Ross 308) with a history of vaccination of parent stock against ND were reared in mentioned place to achieve the study. Newcastle disease vaccine, commercially available ND LaSota ($10^{8.6}EID_{50}$, oil adjuvant inactivated vaccine) of (Jovac company, Jordan) was used to vaccinate chicks via a subcutaneous injection into the lower part of the dorsal neck.

Commercial Elisa kits (SYNBIOTICS corporation, Canada) were used to determine the titers of antibodies against NDV, where such kits used according to the manufacturer's instructions. The experiment was conducted in three parts: the first one was before vaccination while the second after the vaccination. Before vaccination, blood was collected from all one-day-old broiler chicks, and then an ELISA test was performed to evaluate maternal immunity values. After 10 days, the chicks were divided into two groups: Group A (75 birds) were subcutaneously vaccinated with an inactivated oil vaccine against ND, and Group B (75 birds), served as

the control group without vaccination. On day 31 of age (21 days after vaccination), blood was collected from the birds of groups A and B, for checking immune response. third experimental part was depended on serum samples that collected from some farms of commercial laying hens to evaluate the level of immunity in this type of birds and it was achieved by same processing.

Collection of blood and serum preparation for Elisa:

Blood samples were collected from the wing veins of the chicks in a covered test tube and then allowed to clot by leaving it undisturbed at room temperature for 15–30 min. The clot was removedby centrifugation at 1,000–2,000 × g for 10 min in a refrigerated centrifuge. Following centrifugation, serum was immediately transferred into an Eppendorf tube and maintained at 2–8°C.

A statistical comparison of the levels of immunity before vaccination (with maternal immunity) and those of acquired immunity after vaccination was then conducted using a computerized statistical program (SPSS).(12).

Results and discussion

Chicks are vulnerable to infectious diseases, particularly during the first several days of life, as their immune systems do not fully mature until they are 10-14 days old, and maternal antibodies are primarily responsible for protecting newly hatched chicks (4). Therefore, the results of Elisa of day-old chick samples (Table1 & figure 1) showed that the chicks from vaccinated parents contained a high level of maternally derived antibody with a range of 920 to 2192 (average of 1287) at day old and referred to the persistence of maternally derived immunity against ND, which strongly supports the findings of (13 &14), and consequently to the variable immune level in the maternal flock (14).

Such variability was also reported in local layer farms In Basrah City, and the data in (Table 2& figures 2) was included in this study. The data showed the antibody titer against Newcastle disease of 18 commercial layer chickens, 36 weeks old; the mean titer of the chickens was 8581, with a range of 5450–13735. The highest titer in the flock was 13735, which was significantly higher than the target titer (10000), suggesting that some chickens in the flock had an extreme immune response to ND, whereas the lowest titer in the flock was 5450, suggesting a weaker immune response to ND. Therefore, monitoring the flock for signs of ND regular revaccination to maintain immunity is important.

The results of the current study showed that in the vaccinated group, the mean maternal antibody levels varied from 920 to 2192, with corresponding levels at 20 days post-vaccination ranging from 251 to 715, and levels at 30 days post-vaccination ranging from 155 to 956. In the control group, the mean maternal antibody levels varied from 689 to 956, with corresponding levels at 20 days post-vaccination ranging from 132 to 171, and levels at 30 days post-vaccination ranging from 150 to 164 (Table 1 and Figure 1). Overall, the vaccinated group had higher mean maternal antibody levels, mean antibody levels at 20 days post-vaccination, and mean antibody levels at 30 days post-vaccination compared to the control group across all five fields. However, the specific values and trends varied between the different fields, suggesting potential variability in antibody response based on the field of study.

The results of the Elisa test on day 21 after vaccination (day 31 of age) chick samples, (Table 1) showed that the titer of group B (unvaccinated group) declined to an average level of (90.8) which refers to a drop in maternally derived antibody with age, and that also reported by. (15) ;(5) stated that the persistence of maternal immunity in broiler chickens was decreased at 15 to 20 days of age, whereas (16). showed that maternally derived antibodies persisted up to 27 days of age. In addition, the Elisa results showed that group A (vaccinated group) had a value antibody of acquired immunity at an average of (370.4) which is less than that of day-old maternally derived antibodies. This may be due to the interference between maternal immunity and vaccine-induced immunity, which is in agreement with (13) et al. (2015) who demonstrated that the presence of high levels of maternal antibodies interacts with the production of an efficient immune response by vaccination at a young age.

Table 1. Comparison the average of maternal and acquired antibody levels in vaccinated and control groups at various time intervals in broiler farms located in Basra City.

Field	Mean Maternal Antibody Levels	Mean Antibody Levels at 20 Days (Collected 10 days Post vaccination		Antibody Levels at 30 Days (Collected 20 days post-vaccination	
		Vaccinated (n=5)	Control (n=5)	Vaccinated (n=5)	Control (n=5)
1	920	420	155	689	150
2	1142	251	185	374	164
3	927	274	152	402	132
4	1254	292	191	257	171
5	2192	715	443	956	150
Total	1287±526^{A}	370.4±210^{B}	225.2±122^{C}	535.6±284^{B}	153.4±15.02^{C}

values with C letters do not differ significantly, letter B Level of significance at 1% (p<0.01)

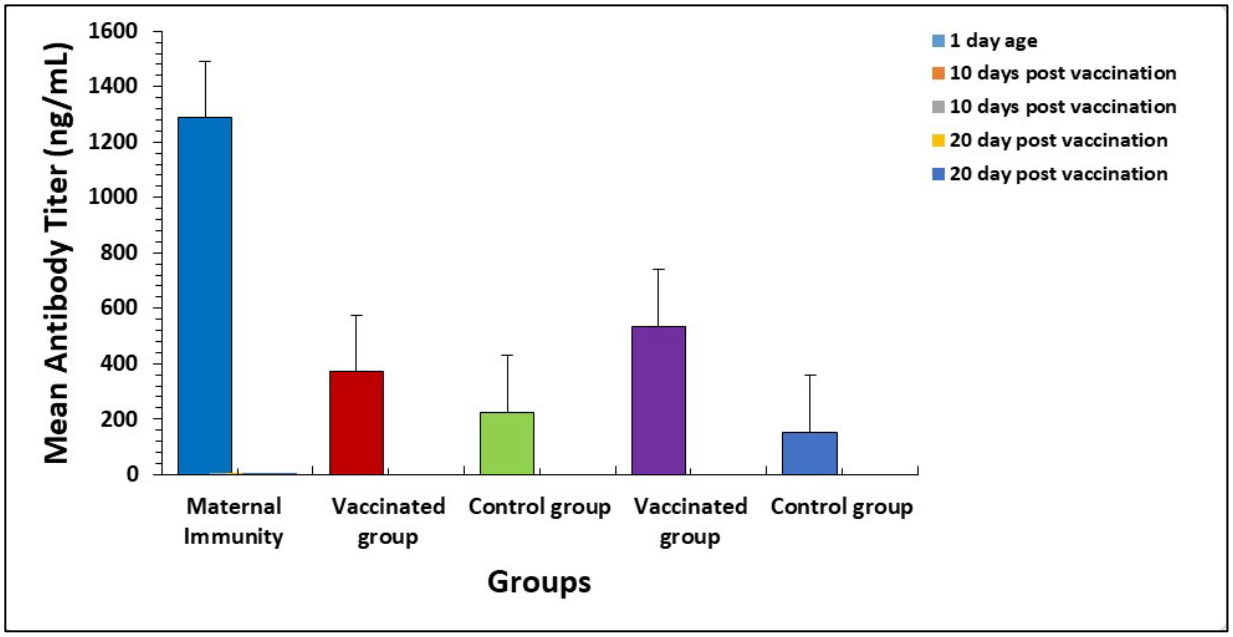

Figure 1. Comparison of the average maternal and acquired antibody levels in vaccinated and control groups at different ages in broiler farms located in Basrah City

Regarding the local layer farms, the results showed that in all fields, the antibody titers in the vaccinated group are consistently higher than those in the control group. This suggests that vaccination has led to an increase in antibody levels in the vaccinated birds compared to the non-vaccinated ones. Overall, the total antibody titer in the vaccinated group is 8729.76±480.29, while in the control group, it is 1337.56±311.94 (Table 2 and Figure 2). This demonstrates a significant difference in antibody levels between the two groups, indicating that vaccination has effectively induced higher antibody titers in the vaccinated birds compared to the control group across all fields in Basrah City. These findings support the effectiveness of vaccination in boosting antibody levels in local layer farms in Basrah City and highlight the potential benefits of vaccination in enhancing the immune response in birds.

Conclusion

The Importance of maternally derived immunity was revealed with immediate protection with no lag period, it eliminates the need to expose the sensitive day-old chick to live viruses, and it prolongs protection by high titers of IgY .These antibodies interact with the production of an efficient immune response by vaccination. So, this study recommended, because of the presence of maternal antibodies, the birds to be vaccinated with a live vaccine, should be tested for the detection of immunity levels before vaccination to avoid the interference between acquired and maternally derived antibodies.

Conflict of interest: no conflict of interest**.**

Table 2. Comparison of Antibody Titers in Vaccinated and Control Groups at Local Layer Farms in Basrah City.

Field No.	Titer	
	Control	**vaccinated**
1	8581.43	1110.034
2	8095.22	1101.695
3	9067.31	2494.836
4	8760.56	1286.982
5	8237.87	1668.655
6	9394.11	1335.855
7	8426.21	1256.136
8	8005.42	1373.288
9	9213.9	1269.153
10	8891.53	1161.309
11	8426.62	1133.382
12	9499.25	1210.576
13	8653.38	1256.136
14	8122.54	1119.458
15	9246.41	1286.982
16	8796.17	1449.891
17	8271.93	1193.22
18	9445.76	1368.436
Total	8729.76±480.29	1337.56±311.94*

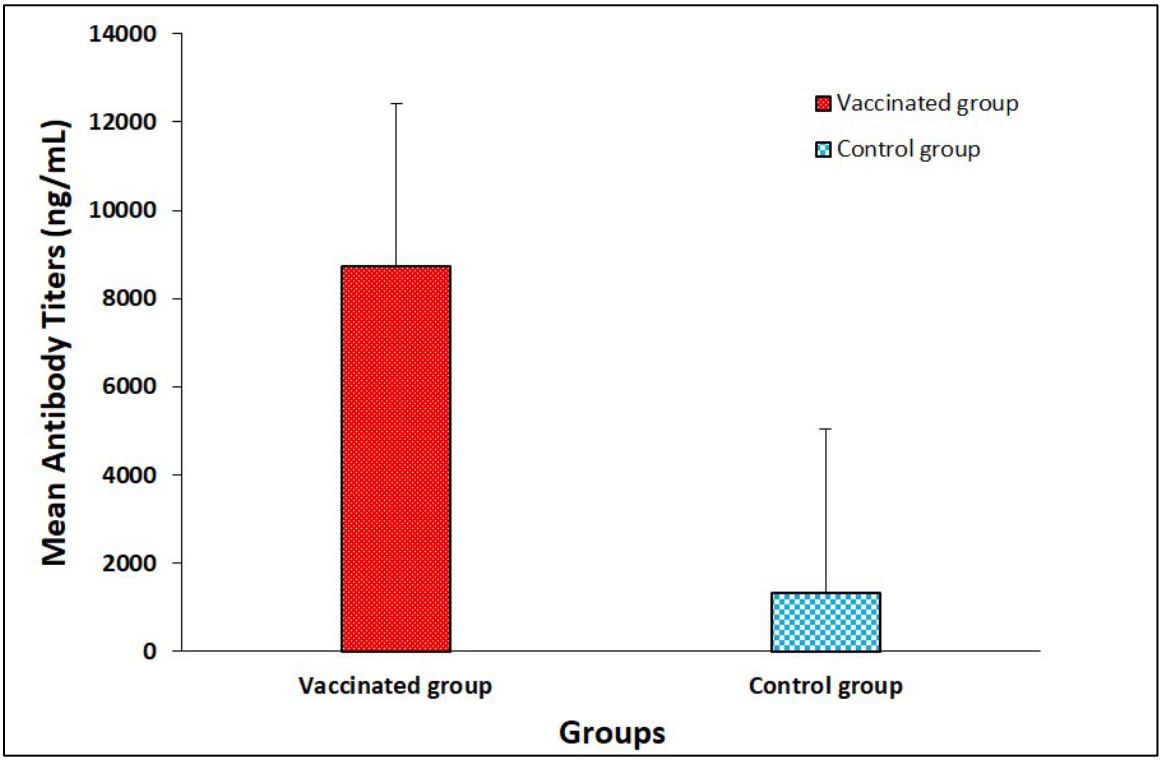

Figure 2. Comparison of Antibody Titers in Vaccinated and Control Groups at Local Layer Farms in Basra City.

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التقييم المصلي المقارن للمناعة الأمومية والمكتسبة لمرض النيوكاسل في الدجاج

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الخلاصة

تشكل الأمراض المعدية، بما في ذلك مرض نيوكاسل ، مصدر قلق كبير في تربية الدواجن. الطريقة الأساسية للوقاية من العدوى الفيروسية هي التحصين باللقاحات لإنتاج أجسام مضادة معادلة. في الأيام العشرة الأولى من الحياة تتم حماية الكتاكيت بواسطة الأجسام المضادة المشتقة من الأم . هدفت هذه الدراسة إلى تقييم والكشف عن قوة وأهمية مناعة الأم في الفترة الأولى من حياة الطائر ومقارنتها بالمناعة المكتسبة. من خلال قيم الأجسام المضادة التي تم الكشف عنها بواسطة اختبار إلاليزا ضد لقاح النيوكاسل. تم تربية إجمالي 150 فرخ دجاج بعمر يوم واحد (روس 308) مع تاريخ تحصين الأمهات ضد مرض النيوكاسل لتحقيق هذه الدراسة؛ كما توجد عينات مصلية تم أخذها من الدجاج البياض الملقحة ضد مرض النيوكاسل,لاستكمال الدراسة الحالية. تم استخدام مجموعة إلاليزا التجارية لتحديد عيارات الأجسام المضادة لفيروس النيوكاسل في دجاج اللاحم والبياض. أظهرت النتائج أن الكتاكيت لديها مستويات عالية من الأجسام المضادة الأمومية عند عمر يوم واحد بمتوسط عيار 1287. انخفضت مستويات الأجسام المضادة الأمومية مع مرور الوقت، وبحلول اليوم 31، كان متوسط المعيار) (90.8) في المجموعة غير المحصنة. كان لدى المجموعة الملقحة مستويات أعلى من الأجسام المضادة في اليوم 31 اي 21 يوم بعد التحصين بمتوسط معيار (370,4) ومع ذلك، فإن مستويات المناعة الأمومية في اليوم الأول من الحياة كانت لا تزال أعلى من مستويات الأجسام المضادة المكتسبة لأن المناعة الأميه دخلت في تطور المناعة المكتسبة بعد التطعيم. وخلصت هذه الدراسة إلى أن مناعة الأم مهمة لتوفير الحماية المبكرة ND، وأوصت بضرورة اختبار الكتاكيت لقياس مستويات الأجسام المضادة قبل التطعيم لتجنب التداخل بين ضد مرض النيوكاسل , والأجسام المضادة المكتسبة.

الكلمات المفتاحية: الدجاج اللاحم، الاجسام المضادة, المناعة, اللقاح.