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PASSIVE IMMUNITY: PART 1

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INTRODUCTION

Maternal Derived Antibodies (MDA) or also known as Passive Immunity are the naturally transfer of immunoglobulins from one individual to another. In birds, maternal antibodies are passed from hyper-immunized or naturally infected breeder hens to the progeny through the egg. This Passive Immunity has relatively short duration, commonly 1-2 weeks and generally less than 4 weeks and its function is to protect young chicks during a period (first few weeks) when their immune system is not fully developed to proper react to an early challenge.

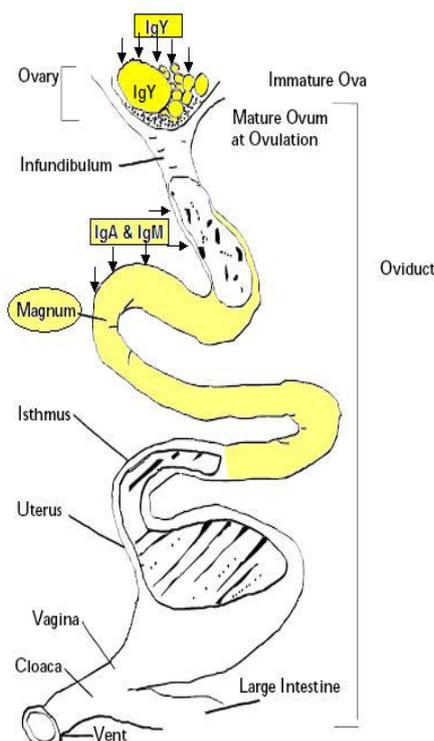
MATERNAL ANTIBODY TRANSFER FROM THE HEN TO THE PROGENY

The transfer of antibodies to the embryo occurs in two steps. First, the antibodies are deposited in the egg yolk and albumin (egg white) and afterwards it is transferred to the embryo.

a. MDA Transfer from the Hen to the Egg

The hens transfer MDA to the egg by depositing the antibodies [IgY, IgA and IgM] in the egg yolk and albumin. As chicken IgG molecule is longer than mammalian IgG, the chicken IgG is referred by some authors as IgY. However, avian IgG (or IgY) is functionally homologous to mammalian IgG (Sharma, 1997). The pathway of depositing immunoglobulin (Ig) in the egg differs between immunoglobulins.

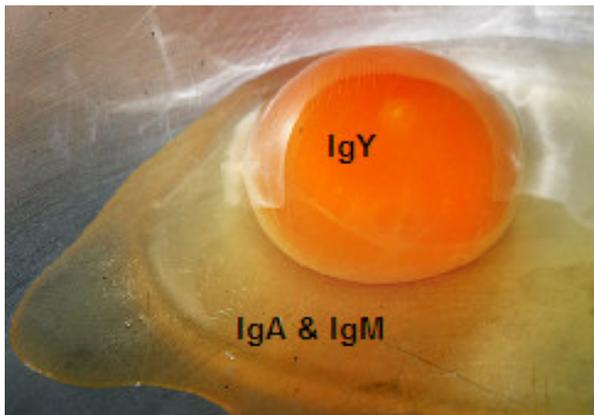
The IgY is the most predominant Ig isotype in the egg yolk. This Ig is secreted by the chicken ovarian into the developing ova (egg yolk) in different stages.



The passage of IgY into the ova is regulated by the follicular epithelium which goes through morphologic changes as the ova grow. This epithelium becomes flatter and thinner in larger ovum allowing the passage of a large amount of IgY. The transfer of IgY through the ovarian follicular epithelium reaches its maximum 3 to 4 days prior ovulation and starts to decrease due to the development of vitelline membrane between the ovum and the follicular epithelium of ovary in preparation for ovulation.

Therefore, as a single hen has several ovas in different stage of development, the amount of IgY transferred to each one is not the same.

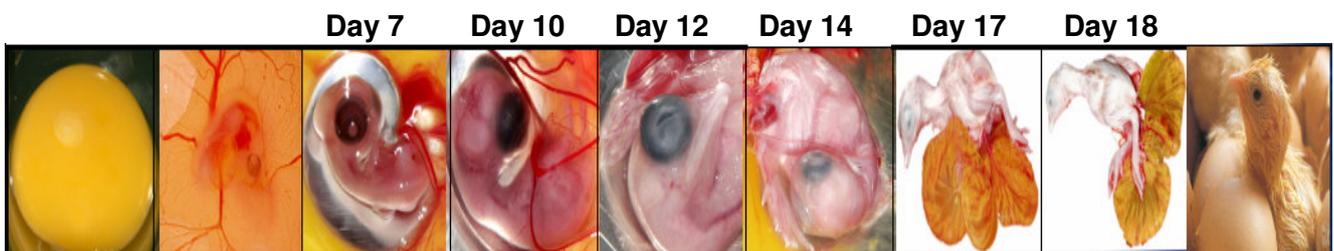
The IgA and IgM are mainly found in the albumen (Rose et al., 1974) and they are transferred to the albumen as a result of mucosal secretion in the oviduct more specifically in the Magnum.



b. MDA Transfer from the Egg to Embryo

The IgY is transferred from the egg yolk to the offspring via the embryonic circulation. The transfer starts from day 7 of embryonic development and reaches its maximum rate 3 to 4 days before hatch.

The amount of IgY transferred to the egg yolk and from the egg yolk to the embryo has been reported to be proportional to maternal serum IgY concentrations. In a work done by Hamal et al (2006), they found that 27 to 30% of hens IgY is transferred to the progeny (Table 1).



IgA and IgM are transferred to the embryo by absorption of the albumen by embryonic gut and may have its major function in the newly hatched chick as a protective Ig in the alimentary tract or as an additional source of protein.

The amount of IgA and IgM transferred to the progeny is less than 1% of the concentration of these Ig in the hens' plasma (Table 1). Besides of low percentage transferred, IgM is the first Ig isotype to be synthesized by the newly hatched chick followed by the IgA and IgY.

MDA ANTI-SPECIFIC AGENTS

The efficacy of MDA in protecting young chicks is variable and depending on several factors such as MDA level and the agent involved. In the Part 1 of this review we will focus in MDA of three agents that cause respiratory diseases: Newcastle Disease virus (NDV), Infectious Bronchitis virus (IBV) and Infectious Laryngotracheitis virus (ILT).V).

However, it is important to stress the fact that it is widely accepted practice to vaccinate poultry against various diseases including Newcastle Disease and Infectious Bronchitis by coarse-spray at the hatchery, even though the birds may possess maternally derived antibody. The rationale for this practice is that the vaccine is beneficial in inducing a local immune response even though maternal antibodies generally interfere with the systemic response (as measured by serologic antibody).

NEWCASTLE DISEASE VIRUS (NDV)

The anti-NDV antibody derived from the hen provides protection for young chicks. Hamal et al (2006) found that the level of NDV-specific antibodies transferred from the hen to the progeny range between 27 and 40% and it is directly related to titres in the hen (Table 1). IgY is also found in the tear of day-old chick at the rate of 1:5 of the serum level (Russell, 1992).

This MDA anti-ND starts to be catabolized as soon the chick hatch. According to Allan et al. (1978) every 4.5 days, twofold of maternally derived HI titer is catabolized by the chicks.

The protection provided by the MDA anti-ND also interferes with the systemic replication of vaccine strains if applied in the presence of high MDA. Therefore, the objective of day-old vaccination with live ND vaccine, as aforementioned, is to efficiently prime the birds, stimulate the local immunity (Cell Mediated Immunity) in the upper respiratory tract and induce early protection in chicks with low MDA.

Oil-emulsion inactivated vaccines have been successfully used in day-old chicks with maternal immunity in the prevention of ND (Alexander and Jones, 2001). The major advantages of those inactivated vaccines are the very low level of adverse reactions in vaccinated birds and extremely high levels of protective antibodies of long duration that can be achieved (Alexander and Jones, 2003).

Moreover, these inactivated oil-emulsion vaccines are not as adversely affected by maternal immunity as live vaccines (Box et al., 1976) because the oil adjuvant acts as stimulus of defense mechanism and disperse antigen slowly. In these circumstances, there is a progressive stimulation of the active immunity while the passive immunity declines and the immune system reaches full competence (Bennejean et al., 1978; Box et al., 1976; Warden et al., 1975.)

Table 1: Progeny plasma Ig concentration as a percentage of the maternal plasma Ig concentration

Antibody type	Breeder Line 1	Breeder Line 2
IgY	31.7 ± 3.79	26.2 ± 3.15
IgA	0.66 ± 0.13	0.90 ± 0.11
IgM	0.74 ± 0.06	0.96 ± 0.09
Anti-NDV antibody (IgY isotype)	31.3 ± 4.52	36.0 ± 4.73
Anti-IBV antibody (IgY isotype)	40.7 ± 3.98	35.5 ± 3.93

Table modified from Hamal et al, 2006

INFECTIOUS BRONCHITIS VIRUS (IBV)

Maternally-derived antibodies for IB virus differ from flock to flock and this is mainly caused by factors like the vaccine strains used, vaccination programs, quality of vaccine application, production systems and bird line. The percentage IgY-anti IBV transferred from the hen to the progeny range between 31 and 41% (Table 1).

MDA for IBV has been demonstrated to be protective. Mondal and Naqi (2001) observed that chicks with high MDA titers anti-IBV had more than 95% protection against IBV challenged at one day of age, however the MDA for IBV seems to decline fast and in the same paper those authors found that the protection at seven days were less than 30%. This is in agreement with what was found by Hamal et al (2006) where they observed that MDA decreased substantially at day 7, and were no longer detected at day 14.

The strong protection observed by the above authors is concluded to be due to the high level of local protection. Because of this, IBV vaccination of maternally immune one-day-old commercial chicks is routinely performed, regardless of reduced humoral immune response in MDA positive chicks.

Talebi et al (2005) found that the MDA anti-IBV of unvaccinated chicks decline slightly faster (half-life of 5 days) than MDA of chicks vaccinated at day one with IB H120 by spray, eye-drop and drinking water methods (half-life of 6 days).

In countries where IB variants strains are present, breeders should to be vaccinated with these strains in order to produce specific MDA.

INFECTIOUS LARYNGOTRACHEITIS (ILT)

Offspring of breeders vaccinated to ILT receives MDA via egg. However, this maternal antibody does not confer protection against infection or interfere with vaccination (Fahey et al., 1983).

Davison et al (1989), assessing the protection provide by ILT maternal antibodies during the first 4 weeks of chick's live, found that chicks from all ages tested (1, 7, 14, 21 and 28 days) were susceptible to infection.

Due to the fact that ILTV infections are usually limited to the upper respiratory tract and viremia is rarely observed, maternal antibodies and secretory immunoglobulins do not correlate well with protection. Protection to ILT virus seems to be mediated primarily by the cellular immune response. Therefore, these points must be taken into consideration in the development of a vaccination strategy against ILT.

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