



# HOW DO VACCINATIONS PROTECT YOUR BIRDS?

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*All chicks are vaccinated at the hatchery, and some chicks receive "booster" vaccinations after they have been in the grow-out house for several days. Have you ever wondered, "How do these vaccinations protect my chicks?"*

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The purpose of all vaccinations is to cause the birds to develop immunity to pathogens. Pathogens are things like bacteria and/or viruses. Marek's, Newcastle, Infectious Bronchitis, and Gumboro are diseases caused by viral pathogens that we normally vaccinate chicks against.

Vaccines against viruses consist of attenuated viruses that are either in cells or freed from cells. Attenuation means to reduce the ability of the virus to cause disease, that is, decrease its virulence. This is done by putting the virus through several replication cycles in embryonic cells. Then the virus is either freed from the embryonic cells or the vaccine is prepared using viruses still in the cells.

For purposes of illustration, we will assume that our chicks are vaccinated with a Marek's disease vaccine. Within minutes after the vaccine enters the body of the chick, it will be "eaten" by phagocytes. These are large cells that occur everywhere in the body. Their function is to remove foreign materials from the body. After the phagocyte has removed the Marek's virus that was in the vaccine, it will then pass a message to certain lymphocytes (white blood cells), it has encountered a foreign pathogen. The lymphocytes that receive the message originated either in the bursa of Fabricius (bursa) or in the thymus.

The bursa is a small gland located in the tail region of the bird. It looks like a flesh-colored fig. The bursa provides an environment in which certain lymphocytes, called B-cells, develop that can produce antibodies. The thymus has a series of six to seven lobes of tissue located on each side of the throat adjacent to the esophagus. Like the bursa, it provides an environment for maturation of lymphocytes, called T-cells, that produce chemicals called cytokines. These are protein-like molecules that have many functions. For instance, they kill unwanted cells that may enter the body, reject foreign tissues, kill viruses, or kill malignant cells.

The message passed from the phagocyte to the appropriate B- and T-cells will be, "B-cells make antibodies, and T-cells make cytokines against Marek's disease virus!" The next question is, "How does the phagocyte know how to do this?" This is still a mystery of science.

As soon as the B- and T-cells receive the "go" message from the phagocyte, they enter the spleen

and attach to "nurse" cells. The B- and T-cells, under the constant care of the nurse cells, swell and soon divide each into two daughter cells. The two daughter cells will divide, and their daughters will divide, and so on. It takes only about 9 minutes for a division to occur. So, in a short time, we have two clones of B-cells formed as well as two clones of T-cells. The first clone of cells is called primary responders, and the second clone of cells is called memory cells.

The first clone of B-cells immediately start producing antibodies against Marek's disease virus and the first clone of T-cells produce cytokines against Marek's virus. The second clone of both B- and T-cells simply continue to divide. These memory cells do not respond during primary responses.

Figure 1 shows antibody levels in the blood that are a direct result of the action of the first clone.

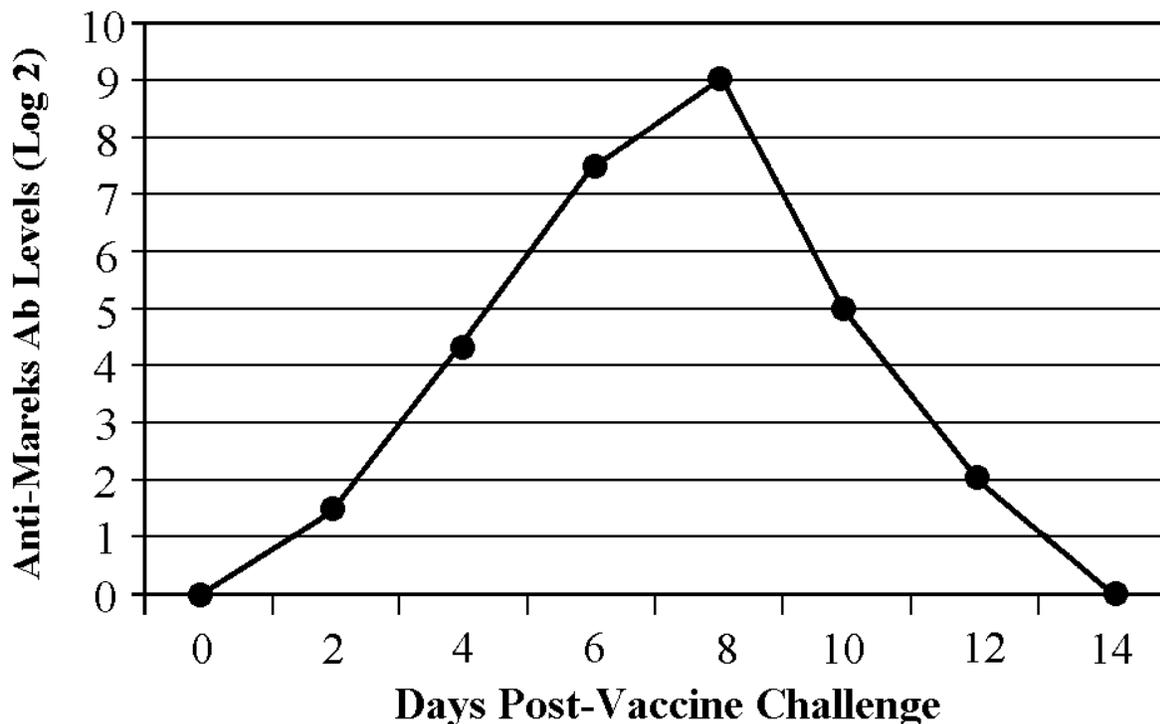


Figure 1. Primary humoral immune response to Marek's virus vaccine challenge.

#### NOTE SEVERAL THINGS ABOUT THESE ANTIBODY LEVELS:

- No antibodies are present until about 2 days after vaccination.
- Peak antibody level occurs at about Day 8.
- The peak lasts only a short time, and antibody levels then begin to decrease.
- By Day 14, all the antibody in the blood is gone. This is a typical primary humoral immune response. The T-cells react like the B-cells and produce what is termed a primary cell-mediated immune response.

"Would primary humoral and cell-mediated immune responses to a viral pathogen such as

Marek's protect the chicks?" The answer is "No." If this were all of the protection the body can give, the chicks would have the disease.

Let's assume that when the vaccinated chicks are 14 days old, an unwanted rat enters the house and leaves behind feces loaded with live and highly virulent Marek's disease virus. Within 12 hours, the virus challenges every chicken in the house. The second clone of daughter cells (both B- and T-cells), called memory cells that did not respond during the primary responses, now responds dramatically.

We do not know what the signals for memory responses are, but the reaction, as shown in Figure 2, is immediate production of large amounts of antibody and cytokines. These memory responses destroy the invading Marek's virus and prevent the chicks from becoming ill. This is termed a secondary or memory immune response.

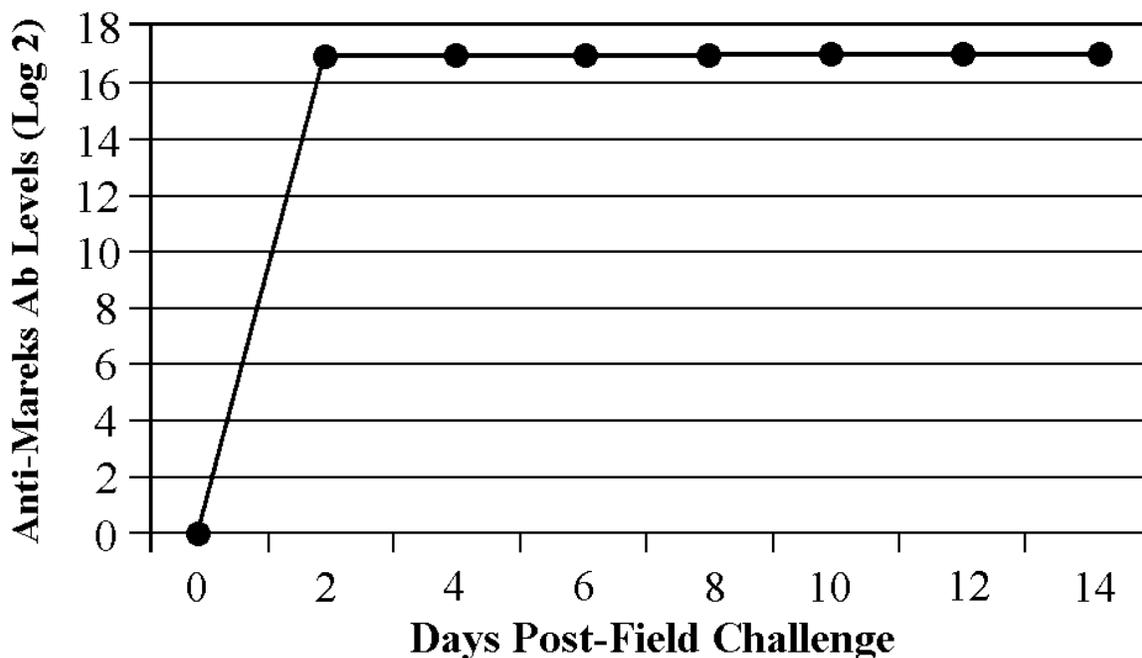


Figure 2. Secondary humoral immune response to field challenge of live Marek's virus.

#### THESE ARE CHARACTERISTICS OF THIS RESPONSE:

- Rapid production and release of antibodies into the bloodstream so that by 2 days after challenge, antibody levels peak.
- Peak antibody levels are normally at least twice as high as levels during the primary response.
- Antibody levels remain high indefinitely. Cytokine production during a memory response has the same characteristics as a secondary response. Cytokine levels rise to high levels very quickly and remain elevated until the virus is cleared from the body.

"Will these memory responses protect the birds against Marek's disease?" The answer is a definite "YES!" This is immunity, and it is correctly defined as the ability to remember a

**pathogenic challenge and then to respond in a protective way whenever this pathogen is encountered again.**

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