Avian Immune System

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Knowledge of the avian immune system is critical when designing a poultry health program.

Immune System Mechanisms in Chickens

Like other avian immune systems, the immune system of chickens is made up of two types of mechanisms—nonspecific and specific.

Nonspecific immune mechanisms include the inherent ways in which a chicken resists disease. These mechanisms, often overlooked when flock managers design a poultry health program, include the following factors:

- **Genetic factors.** Through generations of selection, breeders have developed chicken strains that do not have the receptors required for certain disease organisms to infect them. For example, some strains of chickens are genetically resistant to the lymphoid leukosis virus.
- **Body temperature.** The high body temperature of chickens (105°F–107°F) prevents a number of common mammalian diseases from affecting them. For example, black leg disease and anthrax of cattle are not problems in poultry (although these diseases may occur if the body temperature of a chicken is lowered).
- **Anatomic features.** Many disease organisms are unable to penetrate a chicken's intact body coverings (skin and mucus membranes) or become trapped in the body's mucus secretions. Some nutritional deficiencies (such as biotin deficiency) and infectious diseases compromise the integrity of the body coverings, allowing penetration of disease organisms.
- **Normal microflora.** The skin and gut of a chicken normally maintain a dense, stable microbial population. These microflora prevent invading disease organisms from establishing themselves.
- **Respiratory tract cilia.** Parts of the respiratory system are lined with cilia, which remove disease organisms and debris. High levels of dust or ammonia in a poultry house can cause the ciliary system to become overwhelmed and ineffective.

An understanding of nonspecific immune mechanisms helps explain why good management practices are important in maintaining poultry health. For example, overuse of antibiotics or poor sanitation may lead to a disruption of the normal microflora; poor nutrition may lead to deficiencies that allow disease organisms to penetrate the protective coverings; and selection of disease-resistant strains of chickens may prevent or lessen the effects of certain diseases.

Specific immune mechanisms, which make up the acquired immune system, comprise noncellular (humoral) and cellular components. The **noncellular component** includes **immunoglobulins** (or **antibodies**) and the cells that produce them. Antibodies are specific for the foreign materials (antigens) to which they attach. For example, the antibody against Newcastle disease virus attaches only to the Newcastle virus, not to the infectious bronchitis virus. The **cellular component** of the specific immune mechanisms includes all the cells that react with specificity to antigens *except* those associated with antibody production. The cells associated with this system, T-lymphocytes (T-cells), begin as the same stem cells as B-lymphocytes (B-cells). However, T-cells are programmed in the **thymus**, whereas B-cells mature in the **bursa of Fabricius**.

Active and Passive Immunity

A chicken may become immune to a disease organism by producing antibodies itself or by obtaining antibodies from another animal.

The process of a chicken producing its own antibodies following exposure to a foreign material (such as a bacterium) is called **active immunity**. This process occurs when the bird is exposed to a vaccine or a field disease challenge. Active immunity is adversely affected by anything that damages the cellular or humoral immune systems.

The process of a chick receiving pre-made antibodies from a hen through the egg is termed **passive immunity**. The antibodies are not produced by the chick. Maternal antibodies are present in the yolk, albumen, and fluids of the egg. If a hen has a high antibody titer level to a particular disease, the chick also is immune to that disease for several weeks. However, since the immune system of the chick is not stimulated to protect against that disease, the chick will produce no additional antibodies specific for that disease and will have no memory cells to produce such antibodies in the future. A flock manager must be aware of the maternal antibody levels in chicks to schedule vaccinations. If a chicken is vaccinated when maternal antibody titer levels are elevated, the vaccine may be buffered excessively, resulting in a reduced response. Conversely, if vaccination is delayed, and maternal titer levels are low, a severe vaccine reaction may result.

Lymphoid Organs

The **lymphoid organs** play a major role in avian immunity. As previously indicated, the bursa of Fabricius (site of B-cells) and the thymus (site of T-cells) are considered primary lymphoid organs. Functional immune cells (T-cells and B-cells) leave these organs and accumulate in secondary lymphoid organs, such as the **spleen**, **bone marrow**, and **gland of Harder**. Also, the lungs have lymphoid tissue that helps protect against inhaled disease organisms. This tissue is referred to as the bronchial-associated lymphoid tissue (BALT). Similarly, a series of lymphoid tissues in the digestive tract make up the gut-associated lymphoid tissue (GALT). The GALT includes the **cecal tonsils** and the **Peyer's patches** in the intestine.