Chicken's Immunity To Disease

In this, the first of a two-part article on immunity and vaccination in the chicken, David Shapiro DVM of Salsbury Laboratories Inc, looks at the chicken's immune system.

THERE IS OFTEN confusion concerning the terms "resistant to disease" and "immunity to disease". In addition to their ability to develop immunity to specific diseases, chickens also possess many generalised disease-resisting mechanisms.

Healthy feathering helps the chicken maintain a normal body temperature and an intact skin prevents the entry of pathogens. Careful handling of chicks at the hatchery will reduce skin injuries which might lead to infection. Beak trimming to prevent cannibalism is helpful for the same reason. Proper arrangement of feeding and watering equipment is important to keep the birds from injuring themselves.

The respiratory system has several built-in defense mechanisms. The nasal turbinates filter the air, while the mucociliary system works to remove materials from the upper respiratory tract. Poor air quality, including temperature and humidity extremes and high ammonia levels will compromise these general defenses and increase the chances of respiratory disease.

Enzymes and acids found in the digestive tract work to destroy pathogens. Beneficial bacteria found in the intestines of healthy birds will outcompete disease-causing bacteria. The feeding of certain *Lactobacillus sp.* products is based on this principle.

Interferon, a substance which inhibits virus replication, is produced by cells invaded by viruses.

All of the preceding are nonspecific responses that a chicken can make to pathogens.

The Immune System

Immunity and the immune system come into play when a bird is protected against specific pathogens.

Immunity can be divided into two categories, active and passive. Active immunity occurs as a result of exposure to disease or vaccine. It develops slowly and lasts a relatively long time. Passive immunity is the short-term immunity a chicken gets from the breeder in the form of egg yolk antibodies or from injection of immune serum from an animal which has active immunity.

In order to develop active immunity, the chicken's immune system must be able to recognise a foreign substance and take specific action against it. Any foreign substance capable of stimulating the immune system is called an antigen. The best antigens are usually large proteins. However, a variety of other molecules such as lipids, polysaccharides and nucleic acids, may also act as antigens. Therefore, it is usually the large protein portions of disease agents like viruses and bacteria, that stimulate the chicken's immune system.

Like most body systems, the immune system is composed of cells. The leukocytes (white blood cells) are the most important cells of the immune system. All leukocytes begin as part of a stem cell line most often found in the bone marrow. These stem cells multiply and differentiate into different types of white blood cells.

Leukocytes, like most cells, are composed of a nucleus and cytoplasm. The nucleus contains the genetic material which directs the activities of the cell. It is surrounded by the cytoplasm of the cell where most of the cell's functional machinery is located.

There are five types of leukocytes which are classified as either agranular or granular depending on the microscopic appearance of their cytoplasm. The most important granular leukocyte is the heterophil. Eosinophils and basophils are small in number compared to heterophils and are not as active in the destruction of pathogens. The two kinds of agranular leukocytes are lymphocytes and monocytes. The chart summarises the classification and function of the disease defense cells of the chicken.

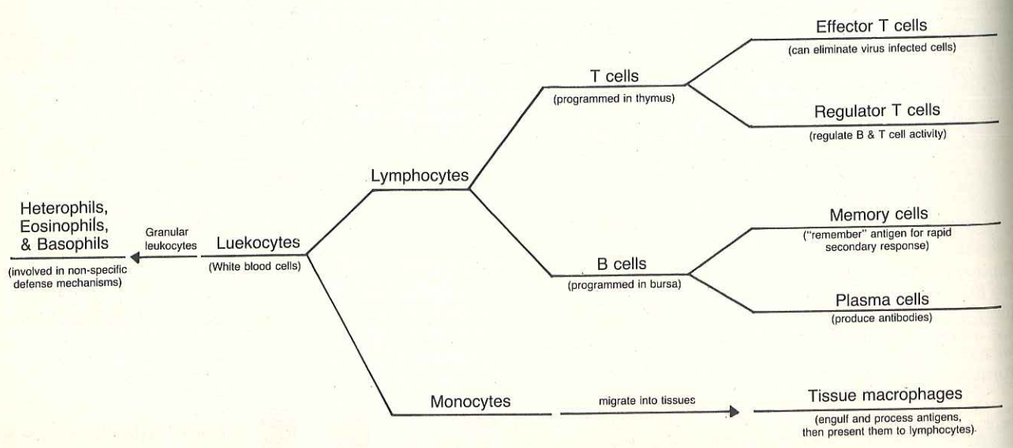
Heterophils phagocytize (engulf) and destroy foreign materials such as bacteria. They are important for disease defense but are more general in function than part of a specific immune response.

Monocytes are larger cells than heterophils but less numerous. They migrate from the blood and become tissue macrophages. These macrophages are found in many body tissues, including lung, liver, spleen and connective tissue. These cells also phagocytize foreign materials. In addition to phagocytosis, macrophages also "process" these foreign antigens for presentation to lymphocytes, the most important cell of the immune system. It is the lymphocyte which responds to the antigen, producing specific immunity in various ways.

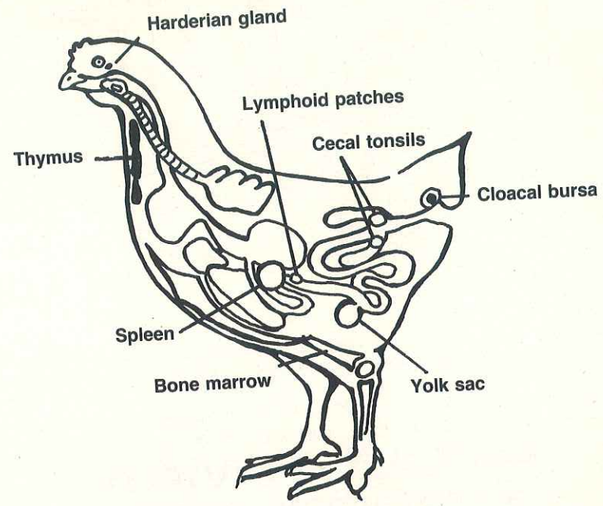
Lymphocytes may be classified as either B lymphocytes (B cells) or T lymphocytes (T cells). After a lymphocyte is produced in the bone marrow, it may migrate to either the cloacal bursa or to the thymus for further "programming". Lymphocytes programmed in the cloacal bursa become B cells while the thymus-programmed lymphocytes become T cells. Once their development is complete, lymphocytes may be found in many different parts of the body.

B cells perform two major tasks. One is the production of antibodies, while the other is their function as memory cells. In response to an antigen, plasma cells produce antibodies, large proteins which are antigen-spe-

CELLS OF THE CHICKEN INVOLVED IN DISEASE DEFENSE



LYMPHOID SYSTEM OF THE CHICKEN



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cific and which assist in the destruction or inactivation of pathogens by combining with their antigenic protein portions. These antibody-producing plasma cells come from B cells. While antibody production gets underway, memory cells are formed. These cells come into play when a chicken is exposed to a specific antigen for a second time. The memory cells "remember" the antigen and the chicken's immune response is much quicker, since the necessary "immune machinery" is already in place. This memory response, or anamnestic response as it is called, explains the fact that a bird's response to a second or "booster" vaccination is stronger and more rapid than the initial vaccination.

There are several different types of antibodies. Some are in the blood, while others are secreted into the respiratory tract or the digestive tract.

T cells do not produce antibodies. T lymphocytes that are "sensitized" to a specific antigen are able to eliminate cells infected by viruses. Some T cells have the job of regulating the function of other lymphocytes.

The immune system is an extremely complex entity. This is only a short

summary of its many components. When the blood is measured for antibodies in order to assess a chicken's immunity this does not tell the entire story. Serum antibody titres may not tell us about the level of local antibodies in the respiratory and/or digestive tract or the status of the T cell system. Often, this local immunity is important in preventing infections.

A breeder hen will pass some of her serum antibodies through the egg yolk to the chick. Because the chick did not produce these antibodies itself, the immunity received from these antibodies is passive immunity. Although usually impractical, serum from an immune bird could be given to another bird to achieve passive immunity. In some cases, the passive immunity the chick receives from the breeder hen, called maternal immunity, may interfere with early vaccination by neutralising the vaccine antigens. □

Immunité des Poulets à la Maladie

Sommaire—Il y a souvent confusion entre les termes "résistance à la maladie" et "immunité à la maladie". En plus de leur capacité à développer une immunité à des maladies spécifiques, les poulets possèdent aussi de nombreux mécanismes généraux de résistance aux maladies.

L'immunité peut etre divisée en deux catégories, l'active et la passive. L'immunité active est le résultat d'une exposition à une maladie ou un vaccin. Elle se développe lentement et dure relativement longtemps. L'immunité passive est l'immunité à court terme qu'un poulet obtient de l'éleveur sous la forme d'anticorps de jaune d'oeuf ou par injection d'un sérum immun comme un animal qui a une immunité active.

Comme la plupart des systèmes du corps, le système immun se compose de cellules. Les leucocytes (cellules blanches du sang) sont les cellules les plus importantes du système immun. Tous les leucocytes commencent comme une partie de lignée cellulaire le plus souvent trouvée dans la moelle des os. Ces cellules se multiplient et se différencient en différents types de cellules blanches du sang.

Le système immun est une entité extremement complexe. C'est seulement un court résumé de ses nombreux composants. Quand on analyse le sang pour connaitre ses anticorps afin de mesurer l'immunité d'un poulet, on n'obtient pas toute la vérité. Les titres d'anticorps du sérum peuvent ne rien nous dire au sujet du taux d'anticorps locaux dans les systèmes respiratoires et/ou digestifs ou sur le statut du système cellulaire T. Cette immunité locale est souvent très importante pour prévenir les infections.

Une poule reproductrice transmettra une partie de ses anticorps à ses poussins par l'intermédiaire du jaune d'oeuf. Comme le poussin n'a pas produit ces anticorps lui-meme, l'immunité reçue de ces anticorps est une immunité passive. Bien que généralement peu pratique, le sérum d'une bete immune pourrait etre transmis à une autre bête pour lui donner une immunité passive. Dans certains cas l'immunité passive, appelée immunité maternelle, que le poussin reçoit de la poule reproductrice peut interférer avec des vaccinations précoces en neutralisant les antigènes vaccins.

Inmunidad Del Pollo A La Enfermedad

Resumen—Existe a menudo confusión en relación con los términos "resistencia a la enfermedad" e "inmunidad a la enfermedad". Además de su capacidad para desarrollar inmunidad frente a las enfermedades específicas, los pollos también poseen muchos mecanismos generalizados de resistencia a la enfermedad.

La inmunidad se puede dividir en dos categorías, activa y pasiva. La inmunidad activa sucede como resultado de la exposición a una enfermedad o a una vacuna. Se desarrolla lentamente y dura un tiempo relativamente largo. La inmunidad pasiva es aquella inmunidad de corta duración que el pollo obtiene de la reproductora mediante los anticuerpos de la yema del huevo o por inyecciones de suero inmune procedente de un animal que posee inmunidad activa.

Como la mayoría de los sistemas corporales, el sistema inmunitario está compuesto de células. Los leucocitos (las células blancas sanguíneas) son las células más importantes del sistema inmunitario. Todos los leucocitos provienen de una línea de células base que se hallan más frecuentemente en la médula ó-sea. Estas células base se multiplican y diferencian en diferentes tipos de células blancas sanguíneas.

El sistema inmunitario es una entidad extremadamente compleja. Este es sólo un corto resumen de sus muchos componentes. Cuando se analiza la sangre para comprobar sus anticuerpos con el fin de determinar la inmunidad del pollo, estos resultados no nos dicen el cuadro completo. Los títulos de anticuerpos séricos pueden no decirnos lo referente al nivel de anticuerpos locales en los tractos respiratorio y/o digestivo o el estado del sistema de células T. Muchas veces esta inmunidad local es muy importante en la prevención de infecciones.

Una gallina reproductora pasará parte de los anticuerpos de su suero a través de la yema del huevo al pollo. Como el pollo no produce por sí mismo estos anticuerpos, la inmunidad recibida de estos anticuerpos se denomina inmunidad pasiva. Aunque generalmente no es práctico, el suero procedente de un ave inmune podría ser cedido a otra ave para conseguir una inmunidad pasiva. En algunos casos, la inmunidad pasiva que el pollo recibe de la gallina reproductora, denominada inmunidad materna, puede interferir la vacunación temprana al neutralizar los antígenos vacunales.

Über die Krankheitsimmunität des Huhns

Zusammenfassung—Die beiden Begriffe "Krankheitsresistenz" und "Immunität gegen Krankheiten" werden vielfach durcheinandergebracht. Hühnern ist nicht nur die körperliche Fähigkeit eigen, Immunität gegenüber bestimmten Krankheiten zu entwickeln, sie besitzen darüber hinaus auch eine ganze Reihe allgemeiner Widerstandsmechanismen gegen Krankheiten.

Die Immunität kann man in zwei Arten unterteilen: es gibt einmal die aktive und zum anderen die passive Immunität. Zur aktiven Immunität kommt es nach Exposition oder Impfung. Aktive Immunität entwickelt sich langsam und hält relativ lange an. Passive Immunität ist demgegenüber von kurzer Dauer: das Küken erhält vom Elterntier passive Immunität durch Antikörper im Eidotter oder durch Injektion eines Immunserums und ist damit wie ein aktiv immunes Tier geschützt.

Das Immunsystem setzt sich wie die meisten Körpersysteme aus Zellen zusammen. Dabei sind die Leukozyten (die weissen Blutkörperchen) die wichtigsten Zellen, die zum Immunsystem gehören. Alle Leukozyten haben ihren Anfang in einer Stammzellenlinie, die man am häufigsten im Knochenmark antrifft. Diese Stammzellen vermehren sich und differenzieren sich dabei in unterschiedliche Typen weisser Blutkörperchen.

Bei dem Immunsystem haben wir es mit einem extrem komplexen Mechanismus zu tun; hier kann nur auf viele seiner Komponenten zusammenfassend eingegangen werden. Wenn eine Blutuntersuchung erfolgt, um auf diese Weise den Immunstatus des Tiers zu ermitteln, dann ist mit diesem Test noch längst nicht alles gesagt. So kann man nicht davon ausgehen, dass uns die Serumtiterwerte auch etwas über das Vorhandensein bzw. den Level lokal präsenter Antikörper sagen, etwa im Atmungs- oder Verdauungstrakt, oder über den Status des T-Zellen-Systems. Oft genug ist diese Lokalimmunität für die Verhütung von Infektionen jedoch von grösster Bedeutung.

Eine Elterntierhenne wird einige ihrer im Serum vorhandenen Antikörper übers Eidotter auf ihr Küken

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übertragen. Weil das Küken diese Antikörper jedoch nicht selbst produ-ziertе, handelt es sich bei der durch diese Antikörper bewirkten Immunität eben um eine passive. Wenn im allgemeinen auch impraktikabel, so könnte doch Serum von einem immunen Tier einem anderen Tier verabreicht werden, um auch diesem passive Immunität zu verleihen. Die passive Immunität, die das Küken über die maternen Antikörper erhält (daher auch die Bezeichnung materne Immunität) kann in einigen Fällen störenden Einfluss auf frühzeitige Impfungen ausüben, indem die Impfantigene neutralisiert werden.

L'immunità alla malattia dei polli

Riassunto—Esiste spesso confusione riguardante i termini "resistenza alla malattia" e "immunità alla malattia". Oltre alla loro capacità di creare un'immunità a certe malattie, i polli possiedono anche in genere molti meccanismi resistenti alle malattie.

L'immunità puo' essere divisa in due categorie: attiva e passiva. L'immunità attiva si presenta come risultato di una esposizione ad una malattia o ad un vaccino. Si sviluppa lentamente e dura per un periodo relativamente lungo. Immunità passiva é l'immunità a corta scadenza che il pollo riceve dal selezionatore nella forma di anticorpi del tuorlo o tramite iniezioni con antisiero, come un animale che già possiede l'immunità attiva.

Come la più parte di sistemi nel corpo, il sistema d'immunità é composto di cellule. I leucociti (globuli bianchi) sono le cellule più importanti del sistema d'immunità. Tutti i leucociti iniziano come parte di una catena cellulare che si trova spesso nel midollo osseo. Questa catena cellulare si moltiplica e si differenzia in diversi tipi di globuli bianchi.

Il sistema d'immunità é un'entità estremamente complessa. Questo é solo un corto riassunto dei suoi innumerevoli componenti. Da un'analisi del sangue per anticorpi, effettuato per verificare l'immunità di un pollo, non si puo' conoscere tutto il corso del processo. I titoli di anticorpi del siero non ci informa forzatamente sul livello di anticorpi locali nel tratto respiratorio e/o digestivo o dello stato del sistema cellulare T. Molte volte questa immunità locale é molto importante nella prevenzione di infezioni.

Una riproduttrice transmetterà tramite il tuorlo una certa quantità dei suoi anticorpi del siero al pulcino. Dato che il pulcino stesso non ha prodotto questi anticorpi, l'immunità ricevuta da questi anticorpi é passiva.

Benché normalmente non praticato, il siero da un soggetto immune potrebbe venir trasmesso ad un altro soggetto per ottenere un'immunità passiva. In certi casi l'immunità passiva che il pulcino riceve da una riproduttrice e chiamata "immunità materna", puo' ostacolare la vaccinazione precoce, neutralizzando gli antigeni del vaccino.