DISEASE RESISTANCE IN LIVESTOCK & POULTRY

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Livestock and poultrymen spend millions of dollars annually to protect their livestock and poultry from infectious diseases. Numerous factors are involved in the entire protection process, many of which cannot be controlled by the producer. Disease resistance is the interaction of numerous biological activities within the animal's body.

Skin - The Body's First Line of Defense

The body's first line of defense against disease is the skin. When the skin is not mechanically disrupted it provides a wall against penetration of numerous disease-producing microorganisms that are continuously in contact with it. Examples of mechanical penetration are bite wounds such as from rabid dogs or cats or the deep penetration of nails or forks that provide an opening for the tetanus-producing organisms. In addition to the protection offered through its continuity, the skin provides various acids and enzymes that counteract disease-producing microorganisms that are present in the environment.

Mucous Membranes - Another Line of Defense

Another example of a first line defense is the mucous membranes that line body openings such as the mouth, eyes, reproductive tract and digestive tube. These membranes also have a number of ways of fighting infection. They produce enzymes and control pH (acidity-alkalinity) which counteracts infection. Many cells making up the mucosal lining have whip-like projections known as cilia, which extend into the body openings. They have a whip-like action with a rapid forward motion that helps to catch and expel foreign bodies such as disease-producing germs. The secretions of the mucosal cells attract foreign bodies which are expelled in secretions such as the nasal discharge. The mucosal cells may also be involved in what is described as local immunity. This is the production of antibodies in a specifc area of the body such as the mucosal lining of the upper respiratory tract or the mammary gland. Local immunity is temporary, as it is lost when the cells producing it deteriorate. Deterioration is a continuous process of the mucosal cells.

The mucosal lining has numerous microorganisms that live continually on its surface. These are known as normal bacterial flora, and their presence aids in counteracting invasions of disease-producing organisms. In some instances, chemotherapeutic agents such as antibiotics may actually be harmful in that they destroy the normal bacterial flora and open the door for invasion of disease-producing organisms.

Inflammation

The signs of inflammation include swelling, heat, pain and redness at the site of the wound or injury. Swelling indicates that there is an increased fluid in the region; heat and redness indicate an increased blood flow to the area. Inflammation encourages increased numbers of white blood cells to the area to act as phagocytic cells and increased antibody production, formation of fibrin clots to hold disease organisms in the area, increased fluid which will aid in diluting the toxic materials in the wound site and increased temperature which will counteract the growth of some infectious organisms.

White Blood Cells Help Fight Disease - Phagocytosis (To Eat)

We can visualize the skin and mucous membranes as the wall of a fort protecting the body against invasion of disease-producing germs. If the fort's wall is broken or penetrated, the body must resort to other means of protection. As in the military establishment, there are "specialized services" in the body to counteract the invasion of disease-producing organisms. One of these protective systems is known as the phagocytic system.

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Like the Marines, this system can be rapidly activated and is highly effective. The system is made up of various white blood cells known collectively as phagocytic cells. These cells (or body-protecting Marines) are located throughout the body but primarily in the blood, spleen, lymph nodes and bone marrow. Some of the cells are mobile and can readily move to the area of invasion or wound. Others are static or attached to the lining or spaces within the body organs. The phagocytic cells have a keen sense of recognition and are attracted to undesirable or foreign objects within the body. Phagocytes attach to the foreign objects such as bacteria or viruses and engulf (eat) them. If the phagocytes are successful, they destroy the disease-producing organisms. If the microorganism is not destroyed, it may be carried by the white blood cells to other parts of the body, thus serving as a means of spreading infection.

Lymphatic System

The lymph system can be visualized as a number of small streams draining into a lake (lymph gland) with one large river serving as a route of passage from the lake into a larger stream or lake. The lymphatic system is composed of tubes similar to blood veins that drain into the lymph glands or filters. The fluid passing through these filters is known as lymph and, following filtration in the lymph gland, passes into the circulatory system. The lymph serves as a flushing fluid to remove the disease-producing organisms and their toxic products from the body. The lymph glands serve as filters (phagocytosis) and site of antibody production. Swollen lymph glands indicate infection in the region draining into the lymph gland. The lymph vessels serving the fingers, hands and lower arms of man drain into the axillary lymph node located in the axillary region (arm pit) of the arm. A swollen axillary lymph node is indicative of an infection in the fingers, hand or lower arm.

Natural Immunity

One form of immunity is known as natural or innate immunity. Some phases of this form of immunity are the variations in susceptibility to disease observed in different species. Examples of species immunity is the occurrence of hog cholera in swine but not in dogs or of measles in humans but not in cattle.

Another aspect of natural immunity is the difference between individuals within a herd or flock. An outbreak of erysipelas in a drove of swine will result in some of the pigs dying while others will recover and some will exhibit no signs of illness. These variations in a specific outbreak may be due to age, maternal antibodies from the uterus or colostrum, inherited differences or unobserved infections that are followed by recovery.

VACCINES AND IMMUNITY

Antibodies Are the Last Line of Defense

When infection progresses beyond the first and second lines of defense, the body can still call upon the reserve (antibodies) in a final effort to protect itself. Antibodies are protein fractions in the fluid portion of the blood (serum) and in some of the other body secretions such as from the mucosal cells lining the body openings. They are secreted by the antibody-forming cells in the body upon stimulation by antigens (vaccines or disease germs).

The antibody-forming cells are distributed throughout the body in the blood (white blood cells), lymph nodes, spleen, liver, bone marrow and mucosa. Antibodies are highly specific, so they will provide protection only against the specific antigen that stimulated their formation or a closely related one. For example, the vaccine for blackleg will not protect the animal against tetanus.

The quantity of protection possessed by an animal is measured by antibody titer or the degree that the blood serum can be diluted and still show protection toward a specific antigen or disease-producing microorganism. The animal that has a titer of 1/500 for the blackleg organism has five times greater protection than an animal that has titer of 1/100. What we are saying is that the blood serum of the first animal could be diluted 500 times and still have demonstrable antibody to neutralize the blackleg organism. Antibody titer may also be used to demonstrate the presence of disease. Unvaccinated cattle with antibody titers in the blood serum of 1/300 for Brucella organisms would be considered reactors for Bangs disease. Such animals have been infected with Brucella organisms (antigens) which stimulate the antibody-producing cells to produce antibodies for the Brucella organism to a titer of 1/300.

Acquired Immunity - Active Form

When an animal is vaccinated or recovers from disease, antibodies are usually produced within the animal itself.

Antigens are usually the protein fractions of disease-producing organisms and foreign to the host. They may produce antibodies by producing disease naturally followed by recovery, or through the use of modified disease-producing organisms (vaccines).

Living disease-producing organisms may invade the body and produce the signs of disease. However, if the body is capable of immune response it may overcome the infection with a resulting high titer of antibody to the specific organism. Recovery from the disease is the best source of high and lasting immunity, but death or crippling may often result. It is too costly and impractical to rely on exposure to disease to produce protection for domestic livestock and poultry. In addition, it can serve as a source of disease spread.

Modern science has provided numerous antigens that will give protection nearly as good as recovery from disease without the hazards of injury or death. These antigens are generally referred to as "vaccines" and are composed of various forms of disease-producing organisms or their secretions.

Bacterins

One of the oldest forms of antigens used to protect livestock from disease is found in the bacterin. Bacterins are killed disease-producing bacteria, so they are safe to use on any animal without fear of spreading disease. The bacteria used in bacterins may be killed by heat, radiation, or chemicals such as formaldehyde. Some of the diseases for which bacterins are often used in veterinary medicine include blackleg, malignant edema, erysipelas, leptospirosis, pasteurellosis and vibriosis. Bacterins are often used in combinations known as mixed bacterins. The most common of these is often referred to as "the triple shot" given to spring calves, consisting of blackleg, malignant edema, and pasteurella organisms. Other mixed bacterins are combinations of killed bacteria that are suggested to be helpful in protecting against enteritis in swine or calves or mastitis in cattle. When combinations of bacterins are prepared for swine they are referred to as "mixed bacterin (porcine)" or for cattle as "mixed bacterin (bovine)".

Toxoids

In some instances, the poisonous products of bacterial secretions (toxins) are used as antigens. These are highly toxic to the animal, so they must be modified to be safely used to produce immunity. Bacterial toxins that are modified by treating with formaldehyde or heat are referred to as toxoids. Toxoids are not injurious to the recipient animal and will stimulate antibody (antitoxin) production. The disease signs are produced by bacterial toxins and can be prevented by the use of toxoids or treated by the use of antitoxins. Toxoids counteract the toxins of disease-producing bacteria but do not affect the bacteria itself. The diseases for which toxoids are available include enterotoxemia (overeating disease) of sheep and cattle, tetanus (lockjaw), and Staphylococcus infections and enteritis in baby pigs.

Inactivated (Killed) Viral Vaccines

Many of the disease problems associated with livestock and poultry are caused by viruses. There are two general forms of viral vaccines: inactivated (killed) and living (attenuated). The killed preparations have the advantage of eliminating danger of disease spread, but the degree and longevity of immunity is not as great as is usually associated with living virus vaccines. Killed viral vaccines are available to prevent distemper in dogs, IBR of cattle, hepatitis in dogs, enteritis in mink, Newcastle disease, shipping fever (PI-3), rabies, warts and equine (horse) encephalomyelitis.

Attenuated Viral Vaccines

The living viral vaccines are more frequently used than the inactivated (killed) viral vaccines. They have the advantage of generally producing a greater and longer lasting immunity, but they may also serve as a means of spreading disease-producing virus as occurred with hog cholera vaccination.

The viruses employed in living vaccines are usually attenuated viruses. This implies that they have been modified by any one of a number of methods so that they will no longer produce serious disease in their natural host but will still stimulate the production of antibodies. One process of attenuation is achieved by acclimating the virus to a foreign host in which it ultimately will actively multiply. After numerous transfers from one foreign host to another of the same species, the viral agent loses its ability to produce disease signs in its natural host but will still stimulate antibodies. The foreign host may be living animals or tissue culture cells of another species.

Disease-producing bacteria may also be attenuated and desiccated for vaccine production. Examples of these vaccines would be the Strain 19 Bangs vaccine and the living swine erysipelas vaccine.

Some of the disease for which attenuated viral vaccines are available include encephalomyelitis of horses; IBR, BVD (mucosal disease), and PI-3 (shipping fever) of cattle; blue tongue of cattle and sheep; distemper and hepatitis in dogs; fowl laryngotracheitis, fowl pox and Newcastle disease of poultry; and rabies.

REMEMBER, IT TAKES THE ANIMAL TWO WEEKS TO PRODUCE THE MAXIMUM PROTECTION TO A SPECIFIC DISEASE THROUGH ACTIVE IMMUNIZATION OR VACCINATION.

Acquired - Passive (Borrowed Immunity)

When antiserums or antitoxins are used, the immunity produced is known as passive immunity. Passive immunity results from antibodies that are

borrowed from another animal and given to an animal that requires immediate protection. This form of therapy is referred to as the administration of antiserum or antitoxin. In contrast to active immunity, passive immunity provides comparatively shorter protection (15 to 25 days), but is immediately available to the recipient. Another form of passive immunity is the immunity from antibodies obtained by the fetus through the placenta or by the nursing animal through colostrum. Antibodies received in this manner will protect the young animal during early life when it has a minimum ability to produce antibodies to a disease. If animals are vaccinated too early in life or while they still have some of the maternal antibodies, a lasting or effective immunity seldom results. This may be overcome by administration of vaccines later in life or by giving a second vaccination (booster shot) when the animal is older.

Vaccines Must Be Handled With Care

Vaccines have their maximum potency immediately after they are manufactured. The potency will gradually decrease under recommended storage conditions. If the care during storage is inadequate a more rapid deterioration will occur.

Never purchase vaccines from suppliers that do not continually keep the vaccines under refrigeration. Keep all vaccines out of the sunlight as much as possible. Vaccines should be kept under refrigeration (never freeze) until used. When vaccines are taken to the field for use they should be kept on ice in an ice chest and away from sunlight until prepared and administered. You cannot detect a deteriorated vaccine by looking at the bottle or the vaccinated animal. Usually the first sign of ineffective protection is a disease outbreak.

Before using a vaccine, read the label or description insert and follow instructions as to the route of administration and dosage. Don't mix several vaccines together unless instructions indicate this is permissible. Administer with a needle small enough to prevent drainage and loss of vaccine. When mixing up a vaccine, use sterile syringes and needles.

Attenuated vaccines are also often referred to as lyophilized or desiccated vaccines. This simply means that the viral product was dried under vacuum while the temperature was kept well below its freezing point. Under these conditions the virus will continue to live for a period of time. The extent of the safe time period for its use is designated on the container. Before the vaccine can be used it must be put in a solution. The diluent is provided with the vaccine and should be added aseptically just before the use of the vaccine.

Attenuated-desiccated viral vaccine should never be left in the sunlight and should always be kept refrigerated but never frozen. When vaccinating out on the range or in the barnyard, the vaccine should be kept on ice until just before use. All syringes and needles should be sterilized by boiling in water. Chemical disinfectants such as lysol or alcohol will leave a residue which will destroy the virus. The success of an attenuated viral vaccine depends on its ability to produce a mild infection in the recipient animal. If the virus has been destroyed, antibodies will not be produced as the mild infection will not occur. Attenuated vaccines should be handled with care as contamination of the premises may serve as a source of infection to highly susceptible animals.

Always use aseptic techniques in preparing and administering vaccines. Contaminated vaccines can cause severe disease outbreaks or acute post-vaccination reactions. When preparing a vaccine always mix thoroughly so that the antigenic material (bacteria or virus) will be administered uniformly to each recipient.

Good records can be invaluable for future reference in case of need for health certificates or occurrence of disease outbreaks. Record the identity and number of animals vaccinated and the exact name or description of the vaccine, the serial number, expiration date, manufacturer and the date the vaccine was administered. Keeping a label from one of the vaccine vials or bottles will provide most of the needed information.

All immunizing agents available for livestock and poultry disease protection are manufactured under the regulations and with the approval of the Veterinary Biological Division of the Agricultural Research Service of the United States Department of Agriculture. All manufacturers of biologicals are licensed by this regulatory agency. The license number is recorded on the container of the biological preparation.

Always remember that vaccination done under the very best of conditions will not always provide complete protection. However, when good vaccines are used according to instruction, maximum possible protection will be achieved. This should be sufficient to prevent serious disease outbreaks in a herd or a flock or in a geographical area.

Always consult your veterinarian before vaccinating.

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