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Animal Health Fact Sheet

DISEASE RESISTANCE IN CATTLE

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The ability of cattle to resist the many disease processes to which they are exposed is truly amazing. And yet, when several adverse factors combine, this resistance can be overcome and result in a herd disaster which is just as amazing. This discussion will be broken down into four major areas. But it is the combined functioning of all four areas that actually provides disease resistance.

1. ADAPTABILITY

Cattle are adaptable animals and can survive in a wide variety of situations and even in very adverse conditions. The cow's body stores the essential nutrients (water, energy, protein, minerals and vitamins) so normal functions continue even in the event of a moderate period of deficiency or starvation. The rumen microorganisms can digest a wide variety of plant materials and the cow then uses the organisms and by-products for her own nutritional needs. However, a period of adaptation is required with feed changes to allow these rumen microbes to adjust. If this is not provided, the cow's resistance may be decreased or toxic products may be produced and disease result.

A similar situation exists with adaptability to heat and cold. Cattle are able to adjust to great extremes, over a few weeks time. Yet one of the greatest stresses for cattle, and a major contributor to respiratory disease, is the wide temperature fluctuations that occur in a 24 hour period during ring and fall in the temperate climates. Rapid change tends to precipitate disease problems.

2. PROTECTIVE MECHANISMS

The skin provides a mechanical barrier that generally prevents the penetration of infectious agents into the more susceptible tissues underneath. There are enzymes, acids and even helpful bacteria on the skin surface to aid this defense. When a cut or break occurs in the skin, the subsequent bleeding aids in washing away infectious agents. The white blood cells (phagocytes) are brought to the site in increased numbers to engulf debris and the remaining infectious agents and inactivate them. However, with some viral agents, these cells are not able to inactivate them but actually protect and transport them further into the body.

A mucous membrane lines all the body openings as well as the digestive, respiratory and reproductive tracts. It serves much the same function in body protection as the skin. It also

provides a mechanical barrier, enzymes, acids and a helpful bacterial population (flora) for protection against invasion. In addition, specialized cells in the mucous membrane secrete fluids to aid in washing away irritants and invading organisms. Special chemicals (antibodies) are also secreted and provide specific resistance at the local (surface) site. Some areas, such as the respiratory tract, also contain cells with small projections (cilia) on them. Their one-way motion aids in propelling mucus and foreign dust and organisms out of the body. These are major factors in the resistance to disease.

Inflammation often occurs after injury to the body or penetration of organisms through the skin or mucous membrane. It is a local reaction and part of the body defense. Inflammation results in redness, swelling, pain, heat and immobilization of body parts. Its role is to protect the body from further injury and to assist in repair of the damaged tissues. It can result in an over-reaction that produces excess scaring, or pain so severe that it impairs the appetite and initiates a self-starvation cycle. The protective mechanism may become a major cause of the current problem.

Fever is an increased body temperature and is another general body defense mechanism. It serves to completely inactivate some viruses; (those which have a narrow temperature tolerance). It also increases the metabolic rate of the body and speeds up all the chemical processes and reactions that go on. This is of benefit for fighting disease but it also uses up huge quantities of energy very rapidly. The high body temperature may cause severe damage to some cells, such as those in the brain.

3. IMMUNE SYSTEM

This is a system of chemical protection which the cow's body uses to protect against agents which have penetrated through the barriers of the skin or mucous membrane. The immune system is best recognized for its protection against microorganisms (bacteria and viruses) but it is also effective against protozoa and even some multicelled organisms (like internal parasites). There are two types of immunity, cell mediated and humoral. The cell mediated immunity acts to increase phagocytosis, remove damaged cells, and increase the resistance of cells to infection.

The chemical produced by the humoral part of the immune system is called an antibody. This is a serum protein (immunoglobulin) that is created in response to and will react with a specific invading agent. This agent which stimulates the production of antibody, is called an antigen. An invading bacteria could be called an antigen (a complex one) and is actually made up of several or many antigens.

The antibodies produced against a wide variety of agents are carried throughout the body in the fluid portion of the blood (serum) and are called circulating (or humoral) antibodies. Some are also secreted locally onto the surface of mucosal lining cells and these are called cell mediated (or local) antibodies.

Many blood tests are devised to detect the presence of the circulating antibodies. The presence of circulating antibodies indicates that the individual cow has been exposed at some time to that specific agent (antigen). It does not guarantee that the animal is protected against further exposure to that specific agent. For example, a cow with antibodies present (a titer) against Leptospirosis may still become ill if exposed to the live agent again. Antibody immunity is very relative and depends on level of exposure as well as other current stresses and general health. This antigen-antibody reaction is very specific and exposure to one strain of an organism may result in an immunity to that specific strain but not to other strains of the same organism.

The use of vaccines is based on the principal of the antigen-antibody reaction. The vaccine serves as the antigen and stimulates the immune system to produce antibodies against a specific agent. Later, when the actual infectious agent penetrates the body defenses, the antibody is present and able to inactivate the invader. Hopefully, enough antibody is present to inactivate all

those agents that invade and prevent disease. This invasion will stimulate the rapid production of additional antibody for future protection.

The use of vaccines is not a fool-proof method of immune stimulation nor does it produce a protective level of immunity in 100% of the animals vaccinated. There is a great deal of individual variation in animals and in their response to any antigen. The immunity produced is relative and depends on many other factors, including the level of exposure. Some infectious agents produce a much better immune response than others and hence are much better suited for use in vaccines. Some of the new biotechnology techniques will provide great improvements in the vaccine products previously available. It will also allow development of new products against agents for which vaccines have previously been ineffective.

When using vaccines, remember that there is a time delay involved. It takes the cow's body time to respond and build the antibodies. Cattle will seldom have any protection from a vaccine until at least 10–14 days following vaccination. With many vaccines the first dose is also just a priming dose and will begin to stimulate the immune system but will not provide a protective level of antibodies until 1–2 weeks after the use of the second (booster) dose of vaccine. Read the label directions on the vaccine and plan accordingly.

The immunity described above is called "active" immunity. It is actively stimulated within the animal to be protected. There is also a passive form of immunity. This comes from either colostrum, where it is produced in the dam and passed to the calf through the colostrum (first milk). Or, it can also come from serum transferred from an animal with a high level of immunity to one without (antiserum). Passive immunity lasts only until the serum proteins (immunoglobulins) are broken down by the body's normal mechanisms (3–4 weeks). Active immunity, on the other hand is re-stimulated each time there is exposure to the disease agent.

4. HEALING CAPACITY

The diseased or injured body of the cow has great healing capacity. If there has been severe blood loss, there is rapid replacement of the fluids, proteins, and the red blood cells. Liver and bone also have great abilities to regenerate cells that are damaged or that die. This healing capacity depends on the specific organ and tissue involved and also the cause of the damage. Some tissues do not repair very well. Nerve tissue repairs damage very slowly if at all. Tendons and ligaments repair slowly and the scar tissue is never as strong as was the original tissue. But, further adaptation by the animal may allow near normal function.

The combined function of all these mechanisms provides cattle with a resistance to disease. It makes possible the raising of healthy vigorous animals.

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