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THE IMMUNE SYSTEM AND RECOVERY FROM SICKNESS IN CATTLE

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INTRODUCTION

Ideally, all diseases could be prevented and beef animals on-feed would finish healthy and with the highest quality of meat. That isn't realistic for most diseases. In spite the best efforts, some animals will become sick and require treatment. Calves with bovine respiratory disease (BRD) that required more than one treatment had decreased quality of meat and economic returns than did calves that did not develop BRD or responded after one treatment. (Hicks, 2006; McNeill, 1999; Wagner, et al., 2006) Calf-hood diseases in heifer calves had measurable effects on maternal performance for several years. (Waltner-Toews et al., 1986; van der Fels-Klerx et al., 2002)

Those data suggest that health of young stock (whether intended to be replacement brood-stock or for meat) deserves attention. With understanding of the diseases, response to treatment and the role of the immune system, appropriate expectations can be developed and improvements can be made where possible.

When an animal becomes sick, one or more factors of its immune system have not performed adequately. The mission of treatment for that animal is to support its immune system and allow the animal to regain its health so it can reach its genetic and nutritional potential. Appropriate selection and use of medication is one tool for treatment, but that medication does not replace the animal's immune system. Clinical response to treatment involves well orchestrated cooperation of the animal's immune system, nutrition and medication. Tremendous advances have been made to understand the immune system, the importance of proper nutrition and the use of effective animal health products to enhance production of beef. Even the most prepared host defenses can be overwhelmed. Detection of sick animals, provision of appropriate nutrition, and proper application of animal health products remain part of the "human element" of managing animal health. Anything humanly possible that can be done to enhance the animal's immune function and reduce exposure to infectious agents will reduce the animal's risk of becoming sick as well as enhance its chances of recovery when treatment becomes necessary.

RECOVERY

Immune protection or defenses are not static. They are influenced by age, calving, vaccination status, and stressors such as adverse weather, weaning, processing or transport. The immune system that is optimally prepared can still be overwhelmed by a large number of organisms and the animal can become sick. The number of organisms or amount of infectious exposure that is required to overwhelm the animal's immune system is also dynamic and varies with the animals functional defenses.

Recognizing that an animal is sick is to recognize that its local and systemic defense mechanisms (immune system) have tried but failed to protect it from invasion by the causative agent. Therefore, during the recovery process, that compromised immune system may need assistance while it is re-enforcing itself.

The time required to fully heal infected tissues is not the same for all tissues of the body and depends, to large part, on the severity of the initial insult. If the host's defenses are totally overwhelmed, death of the animal can result and healing is not an issue. If the animal's defenses can adequately defend it against a lethal insult, healing will begin at its own pace. "Recovery", "healing" or "cure" is the process of returning an injured or damaged tissue as nearly as possible to health. (Smith et al., 1972) There are generally 4 steps that are required before healing is complete: 1) overcoming the offending agent; 2) cleaning up the damaged tissue; 3) repair or replacement of the damaged tissue; and, 4) return of healthy function for that damaged tissue.

Overcoming the offending agent is the initial mission of the animal's defense mechanisms. The animal's inflammatory response to the invading organism is designed to inactivate or kill and restrict spread of that organism in the host. Details of those mechanisms may differ with the specific organism but white blood cells, inflammatory chemical mediators and antibodies are generally involved. Antimicrobial medications contribute only in this step of healing. While it is a critical step and essential contribution to healing, it is important to emphasize that antimicrobial medication assists the activities of the host's defenses in this step. Antimicrobial medications only act against bacterial agents and do not replace those defenses.

Cleaning up the damaged tissue of products of inflammation is primarily performed by the animal's immune system. White blood cells are again the primary work-force. They produce enzymes that liquefy debris or engulf and transport microscopic particulate matter to sites of excretion from the body. Liquefied materials are generally carried away from the site of infection by being absorbed into lymph or blood for eventual excretion from the body.

Repair or replacement of the damaged tissue begins when the tissues are healthy enough to "rebuild." Tissues that are capable of regenerating cells of the same kind are healed by replacement. Tissues that can not regenerate are repaired with fibrous tissue or scar tissue. Whether the tissue replaces itself or repairs with scar tissue often determines the extent of recovery.

Return of function of the damaged tissue is necessary to complete the steps of healing. If the original function of the tissue is critical to life-support (ex. lungs) and those damaged tissues are repaired with scar tissue, function of the repaired tissues may not be adequate even though the tissues are no longer infected.

All of those events occur at microscopic levels. The clinically visible outcome is the net result of multiple microscopic and sub-cellular events. When internal organs such as the lungs are the targets of infection, monitoring of progress of healing is indirect at best. Lungs that are severely affected by the initial infection or do not completely heal, result in prolonged non-productive clinical effects (chronics).

It is a reasonably conservative estimate that healing can require days to weeks. In this day and age of "microwave, high-speed" technology, the biologic time of healing has not shortened and should not be measured in terms of speed or velocity. Any comparison of recovery to a race should be to a marathon; not to a sprint. In either sporting event, preparation before the event increases the probability of a successful outcome, but all participants do not finish equally. Likewise, preparing an animal before its infectious challenge will increase the probability that it will remain healthy, or improve its chance for recovery should it become sick and need treatment.

WHAT CAN BE DONE TO HELP?

What can be done to help prepare the immune system to participate in healing? The degree of preparation may be different depending on the challenge. There are near-term as well as long-term preparatory activities that could be of value.

Anything that can 1) reduce exposure to infectious organisms; and/or 2) enhance the animal's defenses, can be expected to reduce the overall incidence of disease, and to 3) enhance successful response to first-treatment if the animal becomes sick.

To reduce exposure to infectious organisms, hygiene or cleanliness is important. Cleanliness of feeders, water troughs or tanks, bedding, handling facilities can reduce the number of organisms to which the animal is exposed. Because those are "shared" items, one infected animal can contaminate surfaces to which all animals may be exposed. While it is not possible to eliminate most stressors, it is possible to reduce stressors or shorten time that the animal is exposed to those stressors that are known to reduce the animal's immune function. During exposure to recognized stressors, cleanliness is particularly important.

Enhancement of the animal's immune system usually concentrates on vaccination. Information is growing that immune function and health may begin long before an animal is eligible for vaccination. Studies have identified genetic contributors to resistance against some diseases. As more is learned about particular genetic markers, specific selection criteria may be available in the future. The genetic basis for health emphasizes that preparing defenses against disease may actually begin with selection of brood-stock and before breeding season.

In addition to genotypic evidence for health, phenotypic profiles are being used to identify cattle with desirable performance characteristics and that are at greater risk of BRD. (Nkrumah et al., 2007; Paddock et al., 2007; Snowder et al., 2007) Feeding behavior and avoidance behavior are two outward expressions (phenotypic traits) that have been shown to be associated with performance characteristics as well as relative risk of illness. Further validation is in order, but the potential is exciting that traits such as these could be used to select animals with relatively low risk of BRD, or to "profile" and manage cattle based on that risk. Such targeted selection and management could lead to development of appropriate expectations for health care programs and could substantively enhance judicious use of medication.

The importance of colostrum for the calf can not be overstated. High-quality colostrum begins with management of the cow. Management practices are necessary to assure adequate administration and absorption of high-quality colostrum or the calf will not benefit from the colostrum. Appropriate use of biologics in the calf and brood-stock are necessary to prepare them for the challenges by infectious agents they will face in their future.

The immune system is ultimately responsible for the recovery of the sick animal; antimicrobial medication only assists that immune system complete its job. Because of the primary role of the immune system in recovery from disease as well as in defense of disease, efforts should be directed to assure appropriate management to optimize the animals' immune function. Some management practices could be directed to: reduce exposure to infectious agents; minimize extent and duration of stressors; detect and treat animals early in the course of the disease; select brood-stock with traits that are beneficial for that animal's defenses against disease as well as the production traits desired; appropriately manage cattle with traits that are associated with high-risk of disease. Because of the beneficial effects on performance, first-treatment success should be a goal for sick cattle.

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