Immunity and Serum Neutralization Titers for Cattle

Guide B-229

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INTRODUCTION

The immune response of cattle is a very complex system. For the purposes of this guide, we will discuss the immune response in a very general sense. The immune response depends on many factors, including immune status of the dam; amount and quality of the colostrum produced by the dam; level of maternal antibodies the calf received when colostrum was ingested; nutritional, vitamin, and mineral status of the animal; and prior exposure and vaccination status. These are just some of the factors that influence an immune response.

A couple of definitions will help in understanding the immune response. An ***antigen*** is a toxin, protein, or other foreign substance that causes the body to initiate an immune response, usually resulting in the production of antibodies against the foreign substance. ***Antibodies*** are proteins produced by the body's immune system in response to recognition of a foreign substance (antigen), which will help neutralize the effects of that substance.

INNATE AND ACQUIRED IMMUNITY

Innate immunity is the capability an animal is born with to respond to an antigen intrusion. The body is born with a very general response that will neutralize or at least respond to an antigen when introduced. Innate immunity has many components, like physical barriers such as skin, mucus membranes, and stomach acids to name a few; there are frontline responses on the cellular level as well. Innate immune responses are usually very general and do not target specific antigens.

Acquired immunity is a much more specific response. This response occurs at the cellular level and involves many systems, including the lymphatic system, white blood cells, and local cells in the area of exposure. Acquired immunity is added to and fine tuned throughout a lifetime.

ANTIGENS AND ANTIBODIES

In order to produce antibodies, the immune system must be exposed to an antigen, which results in the production of a particular antibody. This exposure can be from natural exposure or vaccination. When the body is exposed to an antigen, many processes are engaged to produce antibodies against that antigen. How and where in the body a particular antigen is presented to the immune system can influence the antibody production. These principles are the basis for the types, routes, and frequency of administration of vaccines. We have learned to manipulate the immune response and prepare an animal's body for the possibility of re-exposure to a particular antigen.

SERUM NEUTRALIZATION TITERS

There are many tools available to evaluate the immune system. One of these tools is serum neutralization titers (SN titers). An SN titer is a measure of circulating antibodies and the level at which the antibodies no longer neutralize a known amount of antigen added to the test sample. While SN titers are a very rough measure of the immune response, they can provide guidelines to help us evaluate the immune system. In order to be interpreted, the results of an SN titer require additional information, such as the animal's vaccination history, age, and health status, and the presence or absence of clinical signs of the tested animal. SN titers are generally very specific for a particular disease, but this can be complicated by diseases that have different

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strains or types that have similar cores, but have different aspects that cause different effects on the body.

To submit a sample for SN testing, a blood sample is drawn and placed into a tube that will allow the blood to clot. The sample is spun in a centrifuge to separate the serum from the cells, and the serum is used for testing. A measured amount of serum is placed into a test well, and then each subsequent test well is a one-half dilution of the previous well. This means the first dilution is a 1:2 dilution, the next well will be a 1:4 dilution, then 1:8, 1:16, 1:32, 1:64, and so on. Next, a known amount of antigen for a particular disease is added to each test well. The last well in which this known amount of antigen is neutralized is the SN titer. For example, if the antigen is neutralized at the 1:32 dilution but not at the 1:64 dilution, then this sample has an SN titer of 1:32. We know there was enough circulating antibody present in the 1:32 dilution to neutralize the known amount of antigen that it was challenged with.

The higher the number of dilution, the greater the amount of circulating antibody. While this does not mean greater immunity to the particular disease, it does suggest that the higher the titer, the better prepared the animal may be to re-exposure to the disease tested for. Also, generally speaking, the immune response to the natural disease cannot be differentiated from the immune response created by vaccination. If an SN titer is negative or zero, then we do not know if exposure to the tested disease has never occurred, or took place so long ago that circulating antibodies have decayed and disappeared. If no SN titer is detected, it suggests that this particular animal may be susceptible to the tested disease.

If an animal has a titer of 1:4, we can make some general statements. For example, we know this animal has not been recently exposed to or vaccinated for the tested disease. We know this animal has produced antibodies, so exposure took place at some time. If an animal has a titer of 1:1,024, this suggests more recent exposure or vaccination. In some cases, the titer will be greater than the testing capabilities. At a point, or "end point," the test will not be carried out any farther. For example, with bovine viral diarrhea (BVD) testing, the end point used by the Colorado State University Diagnostic Laboratory is 16,384. So a titer greater than this will be reported as >16,384. With some diseases, the titers generated by natural exposure to disease are much greater than what is generated by vaccination. Also, the type of vaccine, such as killed versus modified live vaccines, will influence the amount of circulating antibody present. Generally, modified live vaccines create higher SN titers.

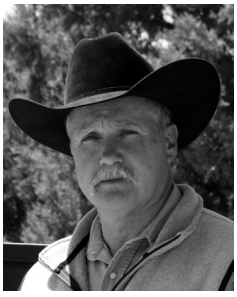
SUMMARY

Understanding these basic principles will help you interpret SN titers. When sample results are obtained, you should already know about vaccine history and frequency. Then the SN titer can be used as a general guideline. It is best used to look at a group of animals rather than an individual. Questions such as "Have these cattle been vaccinated or exposed to a particular disease?" or "Is my vaccination program giving me the duration I am seeking?" can be evaluated using SN titers. It may be prudent to run a few samples on incoming cattle or new additions to look at background immune status. This may help you decide whether or not to vaccinate new additions. While SN titers are not the "end all, be all," they are a tool that—when used and interpreted correctly—can be a very valuable diagnostic test, providing information to aid many management decisions.

FOR MORE INFORMATION

For more information on evaluating the immune status of your cowherd, contact your local veterinarian.

For more general information on SN titers or immunity, contact the author at jwenzel@nmsu.edu or 575-534-7562, or the Department of Extension Animal Sciences and Natural Resources (http://aces.nmsu.edu/ces/animal/). For other Extension livestock and range publications, visit http://aces.nmsu.edu/pubs/_b/.



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