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Key factors for effective immunisation of livestock

Effective immunisation depends on a number of factors that holistically influence an animal's ability to elicit an immune response following vaccination.

These factors include intrinsic factors associated with the animal such as its health status, age, nutritional status/balance, environmental conditions and genetic predisposition. It also includes extrinsic factors associated with the vaccine such as the number of antigens, antigen purity, type of antigens, antigen concentration, immune stimulants and adjuvants and administration efficacy.

Understanding how these factors integrate and influence the immune response elicited by vaccination, is key to effectively managing one's vaccination programme and the effective implementation thereof.

Health status

As a general rule, one should only vaccinate healthy animals that are not in an active diseased state. Animals should be vaccinated two to three months before the expected natural challenge.

Age

Old and frail animals respond less well to vaccines due to a general decline in the immune system. Numerous vaccines are administered to mothers before giving birth. It is important that calves/lambs receive colostrum, as this will provide passive immunity during the first couple of months. Young animals with an immature immune system respond less well to vaccination, hence booster vaccines are often required.

Nutritional status

The nutritional status and metabolic profile of animals greatly influence their ability to react sufficiently. A trace element analysis will give insight as to the mineral balance of a flock/herd. Selenium deficiency is often associated with the inability to react, following vaccination. Supplements containing selenium are available to improve the immune response.

Malnourished animals will be in a negative protein balance. Protein is the main source of amino acids, which are used as building blocks for antibodies produced by the immune system.

Environmental conditions

Any changes in environmental conditions that coincide with vaccination, will have a negative impact on the immune response. Sudden spells of heat or cold or relocation of animals, will place them under stress which will have a negative impact on the energy available to elicit an immune response.

Genetic predisposition

Genetic selection is often founded on the basis of production traits such as high production of meat, wool or milk. Such selection is often at the expense of other traits, including immunocompetence. Focus should be placed on selecting animals that have a history of low disease incidence.

Number of antigens

As a rule, the fewer number of antigens, the better the overall protective rate. Therefore the immune system should not be overloaded with multiple different vaccines or vaccines containing excessive amounts of antigens at the same time, as this may lead to no reaction (zero response) against some of them.

Some vaccines are produced in slow-release formulations to allow for the effective immunisation using multiple antigens.

Types of antigens

The properties of an antigen influences its antigenicity and therefore the immune response. Antigens may be live attenuated, inactivated or subunit. Generally live attenuated antigens are more immunogenic than inactivated or subunit antigens.

Weak immunogenic antigens such as inactivated antigens, are often chemically modified and combined with immune stimulatory adjuvants to enhance its antigenicity and elicit an effective immune response. Inactivated or subunit vaccines, on the other hand, have the benefit of being safe for use in pregnant animals.

Adjuvants

Adjuvants are immune stimulatory components which serve to induce an immune response aimed towards the antigen found in vaccines. Adjuvants traditionally used in veterinary vaccines include mineral oil-based and alum-based adjuvants. Other adjuvants such nucleic acid derived adjuvants have recently been developed and elicit protective immune responses when using poor immunogenic antigens.

During the implementation of a vaccination programme, care should be taken to consider the various factors stated. Consult with your veterinarian for the most effective way of implementing such a programme. SF

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