Proper Use of Inactivated Poultry Vaccines

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Inactivated vaccines now are commonly-used tools to stimulate the immune systems of layers and breeders. For viral antigens, inactivated vaccines are used primarily to induce a prolonged antibody response in birds which have previously received live virus vaccines. For bacterial antigens, these vaccines are typically used in birds which have not previously been vaccinated with a live bacterial vaccine.

Inactivated viral vaccines are used routinely to stimulate high levels of humoral immunity to Newcastle disease virus, infectious bursal disease virus, infectious bronchitis virus and reovirus. Inactivated bacterial vaccines, also commonly called bacterins, are often used to induce immunity to Pasteurella multocida, Salmonella sp., and Haemophilus paragallinarum.

Like all management tools, inactivated vaccines must be correctly handled and used. Proper injection is required for optimum stimulation of the bird’s immune system. There also may be side effects, such as tissue reaction at the site of injection and induction of false-positive tests for mycoplasmas. Proper injection technique, site selection for injection and the timing of injection all can be managed to minimize the impact of these side effects.

Tissue Reaction

In commercial poultry operations, two types of inactivated vaccines are commonly used: aqueous antigens emulsified in a light mineral oil, and aqueous antigens adsorbed to aluminum hydroxide. The aluminum hydroxide and the mineral oil serve as adjuvants. Adjuvants are compounds added to inactivated vaccines to enhance the level of immunity induced by the vaccines. Aluminum hydroxide adsorbed inactivated vaccines generally do not induce circulating antibody levels as high as those induced by oil emulsion vaccines. However, the tissue reaction at the site of injection of aluminum hydroxide adsorbed inactivated vaccines is typically much less severe than the injection site tissue reaction seen following the use of oil emulsion inactivated vaccines.

Tissue reaction at the site of injection is the result of an attempt by the bird’s defense system to “clean up” and “process” the injected vaccine. With the exception of infectious coryza bacterins, most commercially-produced inactivated poultry vaccines are of the oil emulsion type.

There are several important reasons for the concern about tissue reaction following the use of inactivated vaccines. First, the reaction appears to cause some level of bird discomfort. Pullets, following injection with an inactivated vaccine, may appear lethargic or depressed. This can affect feed consumption in individual birds for a few days, and can contribute to poor size uniformity in a flock. This can be observed more easily in commercial egg pullets than in broiler breeder pullets because of the constant feed intake required by commercial layer strains to attain 18-week target body weights.

A second concern is the potential for residual lesions at the site of injection in processed spent breeders and layers. Inspectors may require lesions to be trimmed from affected carcasses. This has been a sporadic but nagging problem at some spent fowl plants for the past 10 years. Trimming and downgrading of spent fowl carcasses can almost eliminate the value of a flock, representing a significant financial loss.

Another possible problem is the reaction which may occur in people if inadvertently injected with an inactivated vaccine. Tissue reaction at the site of injection is much more severe in humans than in chickens and turkeys. Accidental injection of oil emulsion inactivated vaccine into a person can be serious, and prompt medical care should always be sought.

The severity of tissue reaction at the site of an inactivated oil-emulsion vaccine injection depends on a number of factors. A very important one is the type of antigen incorporated into the vaccine. In general, the tissue reaction following injection of an inactivated viral oil-emulsion vaccine is much less severe than the reaction to the injection of a bacterial oil-emulsion vaccine.

More specifically, Pasteurella multocida (fowl cholera) oil-emulsion bacterins, Salmonella enteriditis oil-emulsion bacterins and Haemophilus paragallinarum (infectious coryza) oil-emulsion bacterins generally induce more severe tissue reactions than inac-
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Inactivated oil-emulsion vaccines containing viral antigens such as Newcastle disease virus, infectious bronchitis virus, infectious bursal disease virus or reovirus. The emulsion of inactivated bacteria in mineral oil creates a very potent immunizing agent. This phenomenon is well recognized and is the basis for some types of adjuvants, such as Freund’s complete adjuvant.

**Injection Sites**

The site chosen for injection of an oil-emulsion inactivated vaccine also can influence the extent of the tissue reaction. Less reaction normally is seen when vaccines are injected subcutaneously than when injected intramuscularly. Intramuscular injection, whether in the breast, wing or thigh, is likely to induce a permanent lesion, characterized as a scar of varying size.

Subcutaneous injection, typically placed in the neck tissue, induces a lesion more likely to heal without a visible scar. Highly-reactive inactivated vaccines, such as most bacterins, should be used subcutaneously to avoid the likelihood of inducing permanent lesions in birds that might require trimming during processing.

Injection into the underside of the tail is also used for bacterins. The reaction is not severe and presents an alternative to traditional subcutaneous and intramuscular injection. Tail injection is practical to use in 16-20 week-old broiler breeders and in young turkey breeders, but the tail is too small at 8-12 weeks of age in broiler breeders to allow easy and accurate injection in that area.

Another subcutaneous injection site becoming popular for commercial egg pullets is the groin area.

**Oil Phase Components**

Composition of the oil phase of an oil-emulsion vaccine can have an important impact on the severity of lesions induced by that vaccine. Typically, light-weight, high quality mineral oil is used as the primary component of the oil phase. Various emulsifying agents are used to stabilize the interface of the water (antigen) and oil phases of the vaccine. Plant and animal oils have been used as substitutes for mineral oil, but with disappointing results. Although vaccines containing plant or animal oils induce much less severe tissue reactions than vaccines containing mineral oil, they also generally induce much less of an immune response.

**False-Positive Serology**

One of the side effects of inactivated vaccines is the temporary induction of false-positive mycoplasma serology. Beginning about two weeks following the injection of an inactivated vaccine, a variable percentage of injected birds may be found to be positive when their sera is tested using the rapid plate agglutination test for *Mycoplasma gallisepticum* (MG) and *Mycoplasma synovia* (MS). To a lesser degree, the sera of some birds may react positively when tested with the MG Elisa or MS Elisa.

These test results can be shown to be false-positive (nonspecific) by establishing that the samples are negative when tested with the hemagglutination-inhibition (HI) test. The false-positive reactions are temporary and diminish rapidly, rarely surviving for more than 6-8 weeks. The incidence of false-positive mycoplasma serology is higher following the use of bacterial vaccines than after the use of viral inactivated vaccines. Some of the most extreme cases of false-positive mycoplasma serology has been seen following the use of infectious coryza bacterin.

Among inactivated viral vaccines, the incidence of false-positive mycoplasma serology tends to be higher following the use of a vaccine in which the viral component was propagated in cell culture rather than in embryos.

Although false-positive mycoplasma serology can create uncomfortable situations for poultry companies, the problem can easily be minimized by scheduling the serological monitoring program and the vaccination program so that blood samples are not taken when the likelihood of false-positive mycoplasma serology is high. Breeder replacements should be confirmed serologically as free of MG and MS prior to injection of inactivated vaccines.

**Immune Response**

The primary purpose of inactivated vaccines is to induce uniform immune
response of high intensity and long duration in pullets. In many instances, however, the actual vaccination response in the field is disappointing because the uniformity of response may be less than expected.

The most common reason for the lack of uniformity is improper administration of the vaccine. It is common to find that 10% or more of the individuals within a flock were missed when the flock was injected with inactivated vaccine. It is difficult to determine how many birds within a flock received less than a full vaccine dose, but is likely that a significant number of individual birds receive only a partial dose. Obviously, to achieve the desired result, it is imperative that each bird receive the intended dose of vaccine.

Insuring the accuracy of injection required the establishment and implementation of a program to train personnel and monitor the vaccination results. Training can be almost a continuous process because of the high turnover rate of personnel on vaccination crews within some companies.

Monitoring programs can take several forms. Most commonly, serological titers following vaccination are determined and used to indirectly infer the injection accuracy rate. For example, 20 serum samples may be taken from breeder pullets four weeks following injection with inactivated infectious bursal disease virus vaccine and testing using Elisa. If it is found that the titers of two of the 20 samples are much lower than the other 18 samples, one may become concerned that 10% of the pullets did not receive the inactivated vaccine.

This is merely an indication that an injection problem may exist. Other factors must also be considered. Inconsistency of “priming” with live vaccines can affect the response to inactivated vaccines. Also, a sample of 20 sera is not large enough to make conclusive predictions. Monitoring should include other techniques that allow more accurate assessment of injection accuracy.

**Visual Inspection**

Visual inspection of recently-vaccinated birds is the best method to determine injection accuracy. This is made difficult by the dilemma that white vaccines are injected into white birds. Even with subcutaneous injection, visual inspection of the site is difficult. Traces of vaccine on the feathers are not always obvious. Inclusion of dye in the vaccine is used by some to increase the ease of visual inspection. Although dyes certainly increase the visibility of subcutaneously-injected vaccine when seen on the feathers, traces of the dye may also be visible in the tissues of birds when they are slaughtered. Detection in the tissues of processed birds has deterred most companies from including dye in their inactivated vaccines.

A technique used by many companies is to instruct the vaccination crew to inject all birds in a flock, including culls and “sex slips.” Those birds are placed in a pen and sacrificed at the end of the shift. The injection site is inspected accurately by exposing the site with a pair of scissors.

The site chosen for injection can have an important impact on accuracy. For example, intramuscular breast injection generally can be performed much more accurately than subcutaneous neck injection. Likewise, injection into the underside of the tail can often be performed more accurately than subcutaneous neck injection. If intramuscular breast injection did not carry the risk of inducing permanent lesions in the breast muscle, it would be the preferred site in most cases.

Caution always should be used when injecting inactivated vaccines into the breast. This is particularly true with bacteria. Many vaccine manufacturers do not recommend injection of certain vaccines into the breast muscle. If intramuscular breast injection is chosen, care must be taken to not inject vaccine into the internal pectoral muscle (commonly called the tender). This is the long slender muscle deep in the breast. Vaccination into that muscle often results in death and necrosis of a major portion of the muscle. This can be avoided by using short needles which will not reach the muscle during injection.

It has been found that the site of injection does not have a significant effect on the immune response to the vaccine. Regardless of where the vaccine is injected, it appears that the immune response is similar.

**Summary**

Inactivated vaccines are valuable tools for insuring flock health. Proper management and administration of inactivated vaccines is essential in order to realize their full potential benefits. Injection accuracy is of critical importance. Lesions at the site of injection and false-positive mycoplasma serology are potential consequences of the use of inactivated vaccines. However, techniques and programs are available to minimize their impact.—from Vineland Update