Staph Infection in Broiler Breeders

<u>Understanding Coccidiosis</u>
<u>Prevention Strategies for the Breeder Pullet</u>

Reprint of *The Use of Live Coccidial Vaccines in Broiler Breeder Pullets*

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Introduction

Over the years, there has been tremendous research interest in the immune response to coccidial parasites in poultry. A number of significant reviews of this subject (Rose, 1982:1985; Rose and Wakelin, 1989; Lillehoj, 1993) are available. Several of these reviews illustrate that interest in protecting commercial chickens from the effects of coccidial infection was an objective of many early studies. It is not surprising, then, that the initial live coccidiosis vaccines used in poultry were introduced in the 1960's.

Since then, these products have been used continuously to protect layer and breeder pullets from the adverse effects of coccidiosis. Today, more than 30 years after their introduction, these products have been proven to be an effective method of protecting pullets from this disease. However, many producers have difficulty implementing the procedures in a consistent and cost-effective manner.

As a result, many questions are raised about this technology and the conditions under which it should be used. The objective of this review is to provide the veterinarian or poultry specialist with an update on the use of live oocyst vaccines, to mention problems and pitfalls frequently encountered, and to provide recommendations for the use of this technology.

Biology

Live oocyst vaccines for the control of coccidiosis rely upon the development of acquired immunity to Eimeria parasites. The organisms in the vaccines are alive and pathogenic, although some recently introduced vaccines contain attenuated strains of Eimeria. As these parasites progress through the different stages of their life cycle in the bird= s intestine, they serve as the mechanism to stimulate the cell-mediated immune response of the chicken. It is this response that provides the protection, as the

From a practical standpoint, complete protection (total cessation of oocyst production) is not required to protect breeder pullets in the field. It is necessary, however, to provide a level of protection that prevents the adverse effects of the disease, and, realistically, this can be achieved with a degree of immunity that is less that A complete.@ **In any case, a two-to-three-week interval is required to establish a measurable degree of immune protection, regardless of the species involved** (Stiff and Bafundo, 1993).

bird ages, from the adverse effects of the disease.

As an example, acquired immunity to *Eimeria tenella* can be shown by monitoring oocyst production as a small number of oocysts are administered to young chicks on a continuous daily basis. In laboratory tests of this type, oocyst production reaches a maximum about seven days after the start of the regimen, remaining at this level for several days. By day 14, oocysts production begins to diminish, and 18-20 days into regime, oocyst production ceases (Stiff and Bafundo, 1993). If at this point, birds receive a severe challenge they would be refractory to the infection (Johnson et al., 1985; Long et al., 1986; Stiff and Bafundo, 1993). Experiments such as these have served as models for the practical application of live oocyst vaccines when used in commercial practice, except that oocysts produced by pullets in the field are the source of reinfection and, thus, additional immune stimulation.

Rose (1976) has also illustrated differences in the ability of the species of coccidia to induce the immune response in the chicken. Based on a small number of exposures to oocysts of coccidial parasites, *E. maxima* has shown to be the most immunogenic of the major species and *E. acervulina* was listed as intermediate in its ability to stimulate immune responses.

Of greatest importance, however, is the very low capacity of both *E. tenella* and *E. necatrix* to produce measurable degrees of protection with a relatively small number of exposures to oocysts of these species. This fact is one of the major reasons that *E. tenella* and *E. necatrix* are consistently problematic when vaccines are used in commercial production.

The Objective of a Vaccination Program

Because much of our knowledge of coccidiosis comes from the broiler chicken, it is important to point out that the objectives for managing coccidia in the breeder pullets are substantially different from the objectives used in rearing broilers. In the broiler, primary consideration must be given to maximizing bird performance. Whether this is achieved with a vaccine or chemoporphylactic method, performance is the key measurement in the broiler. **With the breeder pullet, however, the foremost objective must be to provide a controlled exposure to the pathogenic species of coccidia to develop a sound immune response to the parasites.**

Once acquired, immunity will provide the coccidial protection necessary to maintain pullet body weight and uniformity during the latter portion of the growth phase, and also protect the breeder from the coccidial infection as it enters the laying cycle. Inherent in this equation, however, is the presence of the major pathogenic species of coccidia during the first six to eight weeks of the pullet= s life. Provided that the coccidial infections encountered during this interval are not excessive, identification of some lesions and associated diagnostic signs should be protective immunity. Under most situations, it is reasonable to establish the goal of producing soundly protected pullets by the 12th week of life (Bafundo, 1991).

Types of Live Oocyst Vaccines

There are a number of live vaccines used today in breeder pullets, and each may contain different

In the recent past, several vaccine manufacturers have introduced A live attenuated@ coccidiosis vaccines species of coccidia. As a general rule, the species that cause the greatest difficulty in the pullet are *E. acervulina, E. maxima, E. tenella,* and *E. necatrix*. Thus, vaccines for use in pullets should contain these four species at a minimum. In selected locations, other species (e.g. *E. brunetti* and *E. mitis*) may be added to provide a more complete spectrum of immunity. At least one product used in pullets contains all the recognized species and it is wise to provide the pullet as broad a spectrum of immune protection as possible.

In recent years, several live vaccines have been introduced for use in broilers, and, as a rule, these products do not contain the species needed to protect pullets completely. Production personnel should carefully read the labels of products used to ensure that the vaccine is designed for use in pullets.

for use in chickens, and some of the products may be available in the U.S. The coccidia used in these products have been selected for having a abbreviated life cycle (sometimes referred to as A precocious strains@). As a result, these parasites may be slightly less pathogenic and may minimize some of the disease risks associated with the use of live vaccines.

Administration and Effects of the Vaccine

Live oocyst vaccines can be administered in several ways. Traditionally, the vaccine has been placed feed or in water (following a period of feed or water deprivation), usually during the first four days of the bird= s life. A few years ago, techniques to deliver the vaccine via eye spray in the hatchery were developed and produced consistent responses. More recently, gelatin cubes containing oocysts placed in chick boxes at the hatchery were also found to be successful in producing the infections necessary to develop coccidial immunity. The most recent development in oocyst delivery is spray application of the live vaccine in the hatchery. This method employs a spray cabinet similar to those used for administration of IB and NDV vaccines, but uses a spray nozzle that provides a coarser spray with a larger volume of fluids. Once a box of chicks is exposed to the oocyst-containing spray, direct ingestion of the vaccine coupled with the preening response allows most chicks to be exposed to an adequate number of oocysts to stimulate the immune response.

Regardless of the technique used to administer the vaccine, consistency of exposure to oocysts is critical for successful results. The problems that have plagued live vaccines for many years have been related primarily to unequal exposure to oocyst dosage by every member of the flock. Thus, factors such as suspension of oocysts in the delivery liquid and pecking order (larger birds consume more water, feed or gelatin cubes than their smaller counterparts) are known to have significant effects on proper oocyst uptake by all birds in the flock. In a similar vein, administration of oocysts vaccines via nipple watering systems has not provided the consistency of oocyst exposure required for optimal results.

Following administration of the vaccine, measurable *E. acervulina*, *E. maxima* and *E. tenella* infections occur. Signs and symptoms can be observed as early as six days post-vaccination and may persist for approximately 28 days thereafter. Assuming that the vaccine is administered during the first few days of the bird= s life, minor lesions should be seen up to about day 35 with only sporadic occurrence

During this interval, E. acervulina and E. maxima infections may also become sever and have a negative effect on uniformity. Because these species are not as obvious as *E. tenella* (mortality is not a sign), their diagnosis is frequently overlooked in cursory examinations. In addition, these parasites may adversely affect the absorption of vitamins A and E and produce the deficiency symptoms associated with afterwards. Frequently, *E. tenella* infections become sever during this interval (before the immune response develops fully) and mortality due to this species may reach unacceptable levels. Traditionally, vaccine manufacturers have recommended the administration ofamprolium 10 days post-vaccination to minimize the E. tenella challenge that pullets experience. With the current use of spray administration of the vaccine, some manufacturers no longer consider amprolium a necessity.

However, this recommendation is not backed up by an extensive research base and must be considered a departure from the techniques that have proven to be successful for vaccine usage over many years. While there may be some situations where amprolium is not required, pullet producers must recognize the risk in not using this treatment involves severe *E. tenella* infections.

Irrespective of choices made in this situation, it is always necessary to monitor flocks during this period to carefully assess the severity of the *E. tenella* challenge. Periodically, it may be necessary to treat during the fourth or fifth week of the pullet= s life. In some cases, adding vitamins (coccidia impair the uptake of the fat-soluble vitamins A, E, D, and K) has been shown to be helpful in overcoming the negative effects of the coccidial infections during the critical period.

each. To complicate matters, secondary bacterial infections (e.g. Staphylococcus) are frequently identified following severe challenges of these species. Thus, the 28-day period following vaccine administration is critical for the young pullet because of the continual coccidial insult affecting the digestive tract. As mentioned above, careful monitoring, prompt diagnosis and appropriate treatment with vitamin supplementation will help the pullet get through this difficult period successfully.

As pullets enter the second phase of growth (6 to 12 weeks of age), they commonly encounter an *E. necatrix* challenge. In addition to being a poor immunogen, *E. necatrix* does not compete very well in the presence of other coccidial species. As a result, this parasite may appear several weeks after *E. acervulina, E. maxima* and *E. tenella* infections have subsided. It is possible for E. necatrix to cause a considerable degree of mortality and have dramatic effects upon pullet uniformity when it is encountered. McDougald et al. (1990) have shown the effects of *E. necatrix* infections in older pullets (18 weeks of age) to be extremely costly, not only in mortality and uniformity, but also on egg production after the birds enter the laying cycle. For these reasons, it is essential that a sound immune response to this species develops by the 12th week of life. Monitoring birds carefully from the fifth to the 12th week of life so that severe infections can be noted and treated may be necessary in some locations.

Factors Affecting Coccidial Immunity in the Pullet

There are several factors that have been shown to have a significant effect on the ability of breeder pullets to develop acquired immunity to coccidia. These factors, whether alone or in combination, may affect the success of a coccidiosis vaccination program and care should be taken to minimize their adverse effects on the developing immune response in the pullet.

Skip-a-day feeding. While this feeding regime is known to have several economically beneficial effects in the pullet, it is a nutritional stress on the pullet. Research (Bhatti and Lee, 1990) has shown that birds fed every other day do not develop cell-mediated immune response as well as birds fed daily. **Since this is the arm of the immune system that responds to coccidial infections and ultimately protects birds from the disease, be aware that immunity will develop at a slower pace when skip-a-day feeding is used.**

In addition, birds fed every other day experience extended periods of hunger. This forces them to consume litter and with it, coccidial oocysts. Frequently, the level of infection overwhelms the responsiveness of the developing immune system. In those situations where significant problems occur, a daily feeding regime can greatly assist in getting birds back to normal.

Partial house brooding. At placement, breeder pullets are typically brooded in only a portion of the house. As previously mentioned, the initial exposure to the vaccine is only partially responsible for the development of protective immunity. It is the additional exposure to litter that further stimulates the immune response and enhances protection needed for proper growth and production. Consideration must therefore be given to those areas of the house not effectively A seeded@ with oocysts when the entire facility is opened to the birds. Assuming new litter is used with nearly every pullet flock, fewer oocysts will be consumed and marginal coccidial immunity will develop when these brooding techniques are employed.

Disease which impair immune responses. Clearly, infectious bursal disease, Marek= s disease and chicken anemia virus have the ability to impair the development and responsiveness of the immune system of the young fowl. As a result, great care should be taken to ensure vaccination programs are properly designed and implemented. In addition to these viral diseases, a number of mycotoxins have been shown to have negative effects on immune development and the bird= s susceptibility to a number of pathogens. Many integrators, in successfully managing their breeder pullets, utilize their highest quality feedstuffs as a means of minimizing the threat of mycotoxicosis in these birds.

Management factors. Effective litter and environmental management are critical aspects of coccidiosis control programs for all poultry raised in confinement. This fact is especially true when live coccidial vaccines are used. During periods when the immune response to coccidia is developing (the first six to eight weeks of life), efforts must be made to ensure adequate exposure to coccidial oocysts. In very dry environments, sporulation of oocysts may be insufficient to produce the exposure necessary to stimulate the immune response. **Moreover, in humid regions, excessive sporulation may occur and too high a challenge may be produced. During cold weather months, many producers tend to reduce ventilation rates to save heating costs. Reduction in ventilation frequently raises humidity, which leads to a higher litter moisture content and an elevated rate of sporulation.**

Problems have also been encountered when built-up litter is used. This practice may allow an excessive number of field coccidia to infect young chicks before they are immunologically capable of protecting themselves. Litter may also be adversely affected when altering equipment is poorly maintained and leaks and related problems are not fixed quickly. Thus, it should be clear that appropriate management procedures should be in place to regulate environmental conditions so the appropriate degree of coccidial exposure occurs, and that under-or overexposure to the parasites are avoided.

Nutrition. Basically, antibody and cell-mediated responses are protein responses to an antigen. **In diets that are limiting in protein and essential amino acids, it will be difficult for the pullet= s immune system to respond properly.** Thus, it is not surprising that the methionine requirement for immune function actually exceeds that for optimal growth (Tsaigbe et al., 1987). Additional Vitamin E and zinc may also be of some value in maintaining a strong immune response, but these additions must be evaluated from a A bottom line@ perspective (Revington, 1994). In any case, efforts must be made to fine tune pullet rations so that uniformity and efficiency are achieved and adequate immunity results, all at a cost that is not prohibitive to the operation.

Consideration When Treatment is Necessary

In achieving the objective of protective immunity in the young breeder, the pullet manager walks a very fine line between the stimulation of immunity and the production of overt disease. Frequently, the presence of parasites produces pathological problems that must be treated. Therefore, when considering treatments, several facts should be kept in mind:

The available treatments (amprolium, roxarsone and sulfa drugs) have well-defined spectrums of activity.

For problems produced by *E. tenella*, water medications that target this species (amprolium and roxarsone) should be chosen. As a thiamine antagonist, amprolium has been shown to exert activity against *E. tenella* and *E. necatrix*, with minimal or no activity against other coccidial species in chickens. This situation has led to confusion among field personnel, who frequently consider the compound coccdiostatic (particularly against the upper intestinal species).

Despite the fact that extensive usage has led to resistance on some pullet farms, water-administered amprolium is still an ideal choice when outbreaks of *E. tenella* occur. While the specific mode of action of roxarsone (3-Nitro) remains largely unknown despite years of usage, the water-soluble product is also useful for minimizing *E. tenella* infections when they occur.

Due to the water solubility and broad anticoccidial activity, several sulfonamides have been used as effective treatments for coccidiosis. Because of the limited spectrum of activity of the products mentioned above, sulfonamides may be particularly useful when intestinal coccidiosis becomes a problem. Sufonamides are known to interfere with the metabolism of folic acid, and, when used as treatments, the products are primarily coccidiocidal.

Care must be used with their application, because large doses, common in therapeutic applications, may produce toxicity. Hemorrhages, kidney damage and altered growth are known to occur in these situation.Although not approved for use in the U.S., toltrazuril is another broad-spectrum water medication that has shown to be valuable in treating pullet coccidiosis in a number of countries.

Research findings indicate that the best results are frequently attained when water treatments are administered on days when feeding occurs. In addition, familiarity with seasonal water consumption rates is essential for proper administration of any water medication. For example, birds consume less water, and therefore less treatment, during the cooler months of the year.

All too often, treatments are used indiscriminately whenever coccidial lesions or associated diagnostic signs are identified. Moreover, anti-coccidial medications are often administered to the flocks that have no signs of coccidiosis-related problems. These procedures frequently undermine the benefits of mild, controlled coccidial infections in stimulation immunity.

The balance of many environmental factors can change quickly. The delicacy of this balance requires that production personnel promptly identify coccidiosis problems so treatment can be administered in a timely and effective manner.

Summary

In summary, live oocysts vaccines offer the broiler-breeder producer a time-proven method of establishing appropriate coccidial immunity. Experience has shown, however, that these vaccines may not be best for every pullet producer. The use of live vaccines requires care in administration, extensive follow-up during the first six weeks of growth and nearly constant monitoring. Production personnel should be well trained in diagnosing clinical coccidiosis and, more importantly, be prepared to treat it when it is encountered.

Prompt diagnosis, effective treatment and adequate follow-up are essential in making these programs work properly. In addition, high-quality feeds, effective house and environmental management and control of diseases that influence the immune system contribute greatly to successful implementation. Because of the labor intensive nature of these methods, decisions to use these techniques should be made by informed personnel who can evaluate all aspects of such a production tool.