Field results of a necrotic enteritis toxoid vaccine in antibiotic free broiler chickens

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Necrotic enteritis (NE) is an enteric disease of poultry that is caused by the enterotoxins of C. perfringens. The clinical form is an acute disease resulting in high mortality with friable, distended intestines and classic pseudomembranous lesions. A milder sub-clinical form effects performance parameters and has been estimated to have an economic cost of up to USD $0.05 per bird. The standard approach in the poultry industry to protect against this disease has been through the use of in feed sub-therapeutic antibiotics and/or antibiotic ionophores. As the poultry industry has moved to minimize the use of in feed sub-therapeutic antibiotics the incidence of NE has increased. Additionally, NE is a major concern for companies that produce antibiotic free birds. This paper will discuss a new approach in preventing NE in broilers through the use of a NE toxoid vaccine. The toxoid vaccine was developed against C. perfringens alpha toxin (Type A) and adjuvanted with water-in-oil emulsion. A total of 79,865 replacement pullets from a company that produces antibiotic free chickens were vaccinated with the NE toxoid vaccine via subcutaneous injection at 10 and 18 weeks of age. Progeny from breeder hens vaccinated with the NE toxoid vaccine were segregated to allow for placement on selected farms. Mortality from pure house flocks of progeny from vaccinated flocks was compared against progeny from non-vaccinated hens at 8-14 days, 15-21 days, 22-28 days and end of flock. Mortality trend lines demonstrated an advantage for progeny from vaccinated hens during the seasonally high NE challenge period.

Keywords: C. Perfringens; vaccination; necrotic enteritis; broiler mortality

Introduction

Necrotic enteritis (NE) was first recognized as a problem in poultry by Parish in 1961 (1). Necrotic enteritis is typically reported in broiler chickens between 2 and 5 weeks of age raised on litter (2). Both alpha and beta enterotoxins of C. perfringins (Cp) are believed to be responsible for the fibrinonecrotic lesions observed with this disease. In addition to the classic form a milder sub-clinical form affects performance and has been estimated to have an economic cost of up to USD $0.05 per bird. A predisposing factor for necrotic enteritis is intestinal mucosa damage caused by coccidiosis (3).

The standard approach in the poultry industry to protect against this disease has been through the use of in feed sub-therapeutic antibiotics and/or antibiotic ionophores. As the poultry industry has moved to minimize the use of in feed sub-therapeutic antibiotics the incidence of necrotic enteritis has increased. Additionally, necrotic enteritis is a major concern for companies that
produce antibiotic free birds. This paper will discuss a passive immunity approach in protecting antibiotic free broilers from necrotic enteritis with a necrotic enteritis toxoid vaccine.

Materials and Methods

A necrotic enteritis toxoid vaccine was developed against *C. perfringens* alpha toxin (Type A) and adjuvanted with water-in-oil emulsion (4). A company producing antibiotic free chickens was chosen to evaluate the efficacy of this vaccine under commercial conditions against necrotic enteritis. The company has a history of necrotic enteritis outbreaks with associated seasonal peaks in mortality during the cooler months.

A total of 79,865 replacement pullets (Cobb x Cobb) were vaccinated with the necrotic enteritis toxoid vaccine via subcutaneous injection at 10 and 18 weeks of age. The vaccinated pullets were moved to seven separate breeder farms for the production cycle. Eggs from the vaccinated hens were collected and hatched separately. Progeny from vaccinated breeder hens were segregated to allow for placement on randomly selected farms.

Percent mortality was compared for pure flocks of progeny from vaccinated flocks against progeny from non-vaccinated hens. Progeny from vaccinated hens placed in non-pure houses (mixed with progeny of non-vaccinated hens) were assigned to the standard non-vaccinated group.

The time periods examined (8 to 14 days, 15 to 21 days, 22 to 28 days and end of flock) correspond to the typical necrotic enteritis associated mortality observed in this company. Necrotic enteritis occurred with unpredictable timing in individual flocks at any age after 7 days of age. The trial period began on August 29, 2005 on flocks settled and continued for 17 settlement periods through January 30, 2006. The weekly number of chickens in the vaccinated group ranged from 12,900 to 138,000 for a total of 1,309,600 vaccinated chickens and 4,628,547 standard chickens (non-vaccinated) over the entire trial period.

The company protects against coccidiosis with a non-attenuated coccidial vaccine. All chickens received the standard feeding regimen and vaccination program designated by the company. Flocks exceeding mortality greater than 160 birds per day due to necrotic enteritis were treated with sulfamethoxazole for 3 days.

Results and Discussion

Mortality was used to approximate the losses in flocks due to necrotic enteritis. This assumption was based on company flock history associating necrotic enteritis related mortality after seven days of age. Overall weekly average mortality for the 17 week trial group ranged from 3.9 to 8.9% as compared to 5.3 to 13.9% in the standard group. Mortality trend lines for the trial group at 8 to 14 days (Figure 1), 15 to 21 days (Figure 2), 22 to 28 days (Figure 3) and total mortality (Figure 4) for the 17 week period were examined.
Figure 1 Weekly mortality 8 to 14 days. Trial and standard group mortality and trend lines.

Figure 2 Weekly mortality 15 to 21 days. Trial and standard group mortality and trend lines.
Figure 3 Weekly mortality 22 to 28 days. Trial and standard group mortality and trend lines.

Figure 4 Total weekly mortality. Trial and standard group mortality and trend lines.

The highly variable mortality pattern of the large number (4.6 million) of standard program chickens processed over the test period is indicative of the severity of episodic losses in individual flocks due to necrotic enteritis on the standard program. Large numbers of farms tend
to smooth the mortality curve if the losses due to disease occur only on a small number of farms or if the losses are not severe.

Despite a smaller number of farms in the trial group (1.3 million), which would tend to magnify any individual farm outbreaks, the overall mortality pattern in the progeny of toxoid-vaccinated hens was more uniform over time, indicating a reduction in episodic necrotic enteritis losses.

The trend lines for mortality at 8 to 14 days, 15 to 21 days, 22 to 28 days and total mortality show a divergence. The mortality for the progeny of toxoid-vaccinated hens demonstrates a lower overall mortality rate and specific declines in mortality rate during the time periods 8 to 14 days and 22 to 28 days compared to the flocks from the standard program.

Evaluation of the efficacy of a vaccination program for a disease which is episodic and sporadic in nature is very difficult under field conditions. The large number of farms evaluated and the frequency of necrotic enteritis episodes at this company provided an opportunity for a valid field study of the efficacy of passive immunity against *C. perfringens* alpha toxin. This study indicates that passive immunity was effective in reducing the incidence or severity of necrotic enteritis at this company.

References