

CONTROL OF COCCIDIOSIS AND DIFFERENT COCCIDIA OF CHICKEN IN SELECTED TECHNOLOGIES USED IN TROPICS AND SUBTROPICS

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Abstract

Coccidia are common protozoan parasites. In the past, most broiler producers have controlled coccidiosis by providing anticoccidial drugs in poultry feed, this approach is becoming less desirable in light of growing public concern about food safety. Presently, vaccination consist of infecting young poultry with a known dose of live coccidian parasites. This vaccination will immunize poultry against the disease, The probiotic (*Enterococcus faecium*) is a common component of intestinal microbial of normal human and animals. The objectives of this study are: to compare the effect of additive and nonadditive of probiotic feed supplement (*Enterococcus faecium*) in the: diet contains anticoccidia on performance of broiler, diet without anticoccidia or vaccine (control) on performance of broiler, diet contains coccidia vaccine on performance of broiler.

Key words: broiler, anticoccidial, vaccine, probiotic, bacteria.

INTRODUCTION

Coccidia

Coccidiosis is recognized as the parasitic disease that has the greatest economic impact on poultry production. Williams (1998) reported that the annual world wide cost is estimated at about 800 million \$ and that for American broiler industry about \$ 45 million. The estimates include the costs of prophylactic in feed medication for broilers and broiler breeders, alternative treatments (e.g. with amprolium) if the medications fail, and losses due to mortality, morbidity, and poor feed conversion of birds that survive out breaks.

Lillehoj and Okamura (2003) reported that intestinal parasitism is a major stress factor that can lead to malnutrition and lowered performance.

Coccidiosis are ubiquitous, they are every where chickens are reared (traditional, industrial, label or organic/bio farms). Their survival is assured by a highly resistant form of transmission - the oocysts - which may survive for several months in the environment. Coccidia are obligatory parasite (sporozoa) belonging to the phylum of the Apicomplexa characterized by the presence of an apical complex in the free stages of the cycle (sporozoites and merozoites) which invade the epithelial cells. The disease is the result of a breakdown in the balance between:

- 1) **The parasites:** their number, their pathogenicity and their ability to promote immunity in the host.
- 2) **The host:** its susceptibility, including its protection by anticoccidials, and its ability to regenerate from the damage caused by the parasite. Chickens selected for their zootechnical performance are particularly sensitive to coccidia.
- 3) **The environment:** intensive rearing particularly predisposes conditions for coccidiosis.

Eimeria have a direct life cycle (only one host), are very specific to hosts, to sites of development (intestine) and to cell types (epithelial cells of the intestina villi or cells of the crypts). Nine species of *Eimeria* have been described in chickens; seven are currently recognized as valid:

Eimeria acervulina, *Eimeria praecox*, *Eimeria maxima*, *Eimeria mitis*, *Eimeria necatrix*, *Eimeria tenella*, *Eimeria brunetti*.

These seven species are specific to chickens and cannot infect other type of fowl or birds or mammals

They are distinguished by:

1. The morphology of their oocyst, the form of resistance and of dissemination of the parasite in the external environment.
2. Their intestinal location for endogenous development.
3. Their pathogenicity: characteristic intestinal lesions and type of diarrhea (e.g. with or without blood).

After an out break of a specific species of coccidian the flock will develop a resistance to the exposed coccidia species but remain resistant to other infective species. Although there may be some differences between poultry management systems regarding the degree of risk from coccidia, it is generally accepted that the disease may be found in most systems, both indoor and outdoor. Williams (1995) reported that oocysts sporulate readily in poultry house litter. However, they can be damaged by bacteria, other organisms, and ammonia that are also present, and their viability can begin to diminish after 3 weeks.

Anticoccidial (coccidiostat) in feed additives

The effective use of anticoccidial feed additives over the past 50 years has played a major role in the growth of the poultry industry and has allowed the increased availability of high quality, affordable poultry products to the consumer.

These anticoccidial can be classified as:

1. Chemicals which has specific modes of action against parasite metabolism, such as amprolium, clopidol decoquinate, halofuginone.
2. Polyether ionophore such as monensin, lasalocid, salinomycin, narasin, and maduramycin), which act through general mechanisms of altering ion transport and disrupting osmotic balance. Chapman (1994, 1998) and Ruff and Danforth (1996) reported that some degree of resistance to all anticoccidial drugs, including ionophores, has developed.

Williams (1998a) reported that to minimize the effects of resistance, poultry producers rotate the use of various anticoccidial with successive flocks, combine chemical and ionophore treatments, or employ shuttle programs during a flock growth.

Application of these treatment programs depend on seasonal conditions and prevalence of various species of coccidia. In recent years, pharmaceutical companies have not brought new anticoccidial to market. However two potential drug targets, enzymes of the sporozoite mannitol cycle (Allocco et al., 1999; Schmatz, 1997) and trophozoite host one deacetylase, have been recently identified (Schmatz, 1997).

Vaccination

Avian coccidia are highly immunogenic, and primary infections can stimulate solid immunity to homologous challenges. Therefore, it would seem obvious that vaccines could offer excellent alternatives to drugs as a means controlling coccidiosis, efforts to develop various types of vaccines (Lillehoj and Trout, 1993).

Live vaccine

Live vaccine for coccidiosis control have been used to a limited degree by the poultry industry for about 50 years, their effectiveness hinges on the recycling of initially very low doses of oocyst, and the gradual buildup of solid immunity. They have been used primarily to protect breeder and layer flocks (Shirley *et al.*, 1995). However, their use, particularly in broiler flocks, is increasing. Live vaccine contains attenuated or virulent coccidial strains. Paracox (consisting of precocious strains of all seven species of chicken coccidia) and Livacox (consisting of precocious and egg-passage lines) are attenuated vaccine.

All coccidial strains in these vaccines are drug sensitive. Coccivac and Immucox are each composed of several virulent species. All four vaccines are commercially available. All of these vaccines are administered during the first week after hatch and will produce solid immunity when they are used carefully under good rearing condition (Danforth, 1998).

Williams and Catchpole (2000) reported that because live vaccines are multivalent (controlling more than one species), tests of their efficacies require a different approach from tests of the efficacies of anticoccidial compounds.

Williams (1994) reported an advantage of attenuated vaccines is that they have low reproductive potentials, thus avoiding crowding in the specific mucosal areas of infection and resulting in the development of optimal immunity with minimal tissue damage.

It is believed that the drug-sensitive, attenuated strains and wild, native strains interbred, reducing both virulence and drug resistance in local population. Thus the useful period of anticoccidial drugs could be extended by rotating their application with live vaccine (Williams, 1998a).

Recombinant vaccine

Over the past 10 years, much research effort has been spent on the development of recombinant vaccines. Although none are in commercial use, this research has served to highlight the complex nature of the avian host-coccidia interaction. A major hurdle to overcome in the development of a recombinant vaccine is the lack of cross - species immune protection. Other factors impeding the development of a successful vaccine have been recently reviewed (Jenkins, 1998; Vermeulen, 1998), the most important of which is the identification of protective antigens. Many potential coccidial antigens have been characterized and cloned.

Jenkins (1998) reported that a total of 29 DNA sequences encoding immunity-stimulating *Eimeria* proteins from various species and developmental stages have been listed in a recent review.

Many of these antigens are surface proteins or internal antigens associated with organelles such as micronemes (Tomley et al. 1996, 1991), rhoptries (Tomely, 1994) and refractile bodies (Vermeulen et al., 1993, 1994).

Recently (Tennyson and Barta, 2000) a low-molecular-weight immunogenic antigen with a single immunodominant epitope was reported to be present in all endogenous stages of *E. tenella*.

Metabolic antigens from developing sporozoites (Jenkins et al 1991, 1993), merozoite antigens (Brake et al., 1997 and Vermeulen, 1998), and gamete antigen (Wallach et al., 1992, 1995) all elicit various degree of protective immunity.

A delivery mechanism for coccidial vaccines that produces optimum resistance to challenge infection has yet to be determined.

Immunogenic *Eimeria* antigens have been administered as isolated proteins with adjuvants (Brake et al., 1997 and Vermeulen, 1998), as recombinant antigens in live vectors such as nonpathogenic strains of *Escherichia coli*, *Salmonella enterica serovar typhimurium*, poxviruses, fowlpox virus, and turkey herpesvirus (Tomely et al., 1991) and by direct plasmid DNA injection (Jenkins et al., 1998, Kopko et al., 2000 and Lillehoj et al., 1997) with various degree of success.

Probiotic

Probiotic are live microorganisms that, when administered through the digestive route, are favorable to the host's health (Guillot, 1998).

The microorganisms used in animal feed are mainly bacterial strains of Gram-positive bacteria belonging to the types *Lactobacillus*, *Enterococcus*, *Pediococcus* and *Bacillus*. Some other probiotics are microscopic fungi such as strains of yeasts belonging to the *Saccharomyces cerevisiae* species (Guillot, 1998, Thomke and Elwinger, 1998).

Because among the probiotics are microorganisms that are usual host of the digestive tract (*Lactobacillus* and *Enterococcus*) and others that are not (*Bacillus*, *Saccharomyces*). Guillot (1998) studied the ability of some strains of probiotics to colonize the gut of axenic and gnotoxenic chickens and he reported that, a probiotic strain of *Enterococcus faecium* is able to colonize the axenic and gnotoxenic gut after a single administration.

The population size of the strain in the intestines of gnotobiotic animals is similar to the population size of the resident *Enterococcus*.

The different mechanisms of action suggested are:

(i) Nutritional effect

1. Reduction of metabolic reactions that produces toxic substances.
2. Stimulation of indigenous enzymes.
3. Production of vitamins or antimicrobial substances.

(ii) Sanitary effect

1. Increase in colonization resistance.
2. Stimulation of the immune response.

Guillot et al. (1990) in gnotobiotic breeding conditions, they have carried out a controlled caecal coccidiosis with *Eimeria tenella* associated with *Salmonella* carriage and tested the eventual effect linked to the administration to the chickens of a strain of *Bacillus*. They have observed a reduction of the clinical symptoms linked to a better growth in the groups receiving *Bacillus* spores. The results obtained were reproducible and statistically significant.

However, this efficiency is not to be compared to the effect of anticoccidial drugs or antibiotics and no differences against *Salmonella* carriage was observed between treated or untreated animals in this experiment.

Enterococcus faecium

Kumprecht and Zobač (2000) reported that the additives with probiotic include: bioplexes, mannanoligosaccharides, bacteria, live yeast.

According to their specific effects on the intestinal microflora the above additives can be divided into three subgroups (PPP):

1. Probiotic-preparations containing stabilised culture of exactly defined microorganisms as active ingredients.
2. Probiotics-biological additives facilitating fast growth of favourable intestinal microflora (protein hydrolysates from fish and yeasts, fructo oligosaccharides, etc.).

3. Parabiotics-additives protecting the intestinal mucosa and stimulating the immune system (glutamine).

Nowadays, active ingredients of many probiotic preparations are bacterial strains *Enterococcus faecium* M-74 or C-68, as a result of continuous supplementation of these bacteria to chicken broiler diets significantly ($p < 0.05$) higher body weight (by 4-5%) were observed in comparison with control, and also reported up to 2.5 time higher cellulase activity in caecal contents at $p < 0.01$ was observed in broilers that were fed diets supplementation with these bacteria. The advantages of these bacteria are higher resistance against extreme internal and external conditions. Lindgren, (1978); reported that the prototype strains *Enterococcus faecium* M-74 shows several characteristic features. It is non-pathogenic, non-haemolytic, and non-proteolytic and has an excellent propagation potential. Its generation time varies between 18 and 20 min. Further virtues include a high adaptability to environmental conditions (particularly changes of temperature PH) and an intensive homofermentative conversion of a number of Sacharide into L-Lactic acid. The *Enterococcus faecium* is cultured commercially and is used as a component of a number of probiotic products of which Lactiferm is the best known. The exclusive manufactures of this product are the Swedish company AB Medipharm and its production unit Medipharm CZ Ltd., Starovice near Hustopeče, Czech Republic.

CONCLUSION

Coccidia are common protozoan parasites. They are present in all most all chicken and turkey flocks. Heavy infection of coccidia cause serious disease and will kill many chickens.

Chickens of all ages can come down with coccidiosis, but 4-16 week old chickens are most commonly affected.

In the past, most broiler producers have controlled coccidiosis by providing anticoccidial drugs in poultry feed, this approach is becoming less desirable in light of growing public concern about food safety. Presently, vaccination consists of infecting young poultry with a known dose of live coccidian parasites.

This vaccination will immunize poultry against the disease. The probiotic (*Enterococcus faecium*) is a common component of intestinal microbial of normal human and animals. The advantages of these bacteria are higher resistance against extreme internal and external conditions. It is non-pathogenic, non-haemolytic, and non-proteolytic and has an excellent propagation potential.

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