Efficacy of anticoccidial drugs in broilers – based on anticoccidial sensitivity tests in the period 2000-2012

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Abstract

In order to compare the sensitivity of Eimeria isolates to different anticoccidial drugs, in-vivo anticoccidial sensitivity tests (ASTs) can be used. The current paper summarizes the results of such ASTs carried out on 134 field Eimeria isolates from Europe, Middle East and Africa collected between 2000 and 2012. The following anticoccidial products have been tested: polyether ionophore products (lasalocid, maduramicin, salinomycin, monensin, narasin) and synthetic products (robenidine, decoquinate, diclazuril) as well as the combination of narasin-nicarbazin.

The combination of narasin-nicarbazin, lasalocid, decoquinate and robenidine demonstrated highest average efficacy when considering improvement in daily weight gain versus control groups (57.4%, 50.7%, 45.5% and 42.8% improvement respectively). Lasalocid demonstrated the most consistent results (SD 19.6).

E. acervulina strains showed highest sensitivity to decoquinate, followed by the combination of narasin-nicarbazin and robenidine. E. maxima strains were most sensitive to lasalocid. E. tenella strains showed highest sensitivity to decoquinate, followed by lasalocid.

Key words

efficacy, sensitivity, Eimeria, coccidia, anticoccidial

Introduction

Coccidiosis of broilers is a protozoal disease caused by unicellular eukaryotic organisms of the genus Eimeria. Birds get infected by ingestion of sporulated oocysts from the environment. Eimeria are intracellular parasites. Once the oocysts are ingested they release sporozoites which invade living enterocyte cells. There they grow and multiply which disrupts the normal function of the host cell and causes its death. Depending on the infection pressure and the virulence of the strains, Eimeria might cause clinical or subclinical coccidiosis. Oocysts are very resistant to environmental conditions and disinfectants. Therefore, the disease is ubiquitous. If not controlled efficiently, coccidiosis is one of the most economically important diseases in modern broiler production (Williams, R.B., 1999).

The most widely used method for control of coccidiosis is the in-feed application of anticoccidial products. At their recommended dosages the products are not detrimental for the birds, but prevent the parasite to multiply or survive, thus preventing the development of the disease. The specificity of the broiler production and the nature of the disease require long term application of anticoccidial
products. Due to their extensive use, the aspect of resistance development becomes more and more important (Mathis et al., 1984; Chapman, 2007).

In order to compare the sensitivity of the field *Eimeria* strains to different anticoccidial drugs an *in-vivo* anticoccidial sensitivity test (AST) can be used. The current paper summarizes the results of 134 ASTs carried out on field *Eimeria* isolates originating from farms from Europe, Middle East and Africa for the period 2000-2012.

During the study the following anticoccidial products have been tested: polyether ionophore products (lasalocid, maduramicin, salinomycin, monensin, narasin) and synthetic products (robenidine, decoquinate, diclazuril) as well as the combination of narasin-nicarbazin. All the products have been tested in their highest EU registered dose. The efficacy of the products was determined by the reduction of the lesions produced by *E. acervulina*, *E. maxima* and *E. tenella* as well as the improvement of the weight gain of the treated groups in comparison with infected untreated control groups (IUCs).

**Materials and methods**

In the period 2000-2012, a total of 134 field isolates have been collected from different farms in Europe, the Middle-East and Africa and subjected to an anticoccidial sensitivity test (AST). The tests have been performed by INRA, Nouzilly, France. The number and species of *Eimeria* were determined in each isolate. For the purpose of the test *Eimeria*-free birds were used. Each test consisted of an uninfected untreated group, an infected untreated group and treatment groups supplemented with various anticoccidial drugs according to their registered dose. After reproduction of the isolate, each bird with the exception of birds from the uninfected untreated group was inoculated with an infection dose, determined by titration in order to cause severe coccidiosis (lesion score of minimum 3 and at least 25% performance impairment in untreated birds). Several parameters, such as weight gain, feed consumption, lesion scores (according to Johnson and Reid, 1970) and oocyst shedding were evaluated and the data were statistically analyzed. The efficacy of the different anticoccidial treatments was evaluated on the base of improvement in respect to the infected untreated animals.

Zootechnical performance is expressed as anticoccidial improvement (%), being the difference in daily growth in comparison with the control groups where the negative control group would be 100% and the positive control group 0%.

All the data between 2000 and 2012 were compiled and analyzed. The averages of the lesion scores and the anticoccidial improvement per treatment were calculated over the whole period.

**Measurements**

The following parameters were evaluated: effect of the different anticoccidials on the zootechnical performance, based on the weight gain improvement in treated in comparison to untreated birds, as well as the parasitological effect measured by lesion score reduction for the three main pathogenic species for broilers (*E. acervulina*, *E. maxima* and *E. tenella*).

**Results**
Only one ionophore product (lasalocid), two synthetic products (robenidine and decoquinate and the combination of narasin-nicarbazin resulted in an average weight gain improvement of more than 40%, (50.7%, 42.8% 45.5% and 57.4% improvement respectively). The most consistent effect amongst them was obtained with lasalocid (SD 19.6) (Fig 1).

Fig. 1  Anticoccidial efficacy expressed as weight gain improvement, being the difference in daily growth in comparison with the control groups

![Anticoccidial efficacy (average improvement AST 1 - 134)](image)

E. acervulina strains showed highest sensitivity to decoquinate, which resulted in a lesion score reduction of 42.5% in comparison with IUCs, followed by the combination of narasin-nicarbazin and robenidine (38.8% and 38.1% respectively) (Fig.2). E. maxima strains showed highest sensitivity to lasalocid (lesion scores reduction of 45.6%), followed by the combination of narasin-nicarbazin and robenidine with a reduction of 26.8% and 19.2% respectively (Fig.3). E. tenella strains showed highest sensitivity to decoquinate – lesion score reduction of 73.2%, followed by lasalocid and the combination of narasin-nicarbazin (40.5% and 37.3% respectively) (Fig.4). The monovalent ionophore products (salinomycin, monensin, narasin) as well as
the glycoside ionophore product maduramicin showed lower efficacy demonstrated by weaker sensitivity of the different *Eimeria* species varying between 7.3% and 33.1%. The most sensitive to them were *E. acervulina* strains and the most resistant were *E. maxima* ones. In terms of average improvement monensin and salinomycin were slightly better (31.0% and 30.8% respectively) than maduramicin and narasin (18.9% and 18.3% respectively). The lower efficacy of the monovalent ionophores could be related to their extensive overuse as well as to the cross-resistance amongst them (Chapman and Hacker, 1994). On the other hand the divalent ionophore lasalocid showed a markedly better efficacy (50.7% improvement), which may be due to the difference in its mode of action. The synthetic product diclazuril provided average improvement of only 15.6%.

**Discussion and Conclusion**

All the products showed variable results in the respective tests with the different isolates, depending on the particular isolate’s sensitivity. The ionophore products in general were more consistent in their efficacy, while the synthetic products showed higher variations. This is probably due to the different patterns of the resistance development for both ionophore and synthetic products. When comparing the anticoccidial improvement amongst the ionophores, lasalocid showed the best results. The combination product containing narasin and nicarbazin showed numerically highest anticoccidial efficacy. The synthetic products robenidine and decoquinate showed similar efficacies but diclazuril lagged behind. Lasalocid demonstrated the most consistent results. Of course, these results are averages and cannot simply be used for generalized advice.

**Summary**

The most widely used method for control of coccidiosis in broilers is the in-feed application of anticoccidial products. In order to compare the sensitivity of *Eimeria* isolates to different anticoccidial drugs, *in-vivo* anticoccidial sensitivity tests (ASTs) can be used. The current paper summarizes the results
of such ASTs carried out on 134 field *Eimeria* isolates from Europe, Middle East and Africa which were collected between 2000 and 2012. The following anticoccidial products have been tested on a routine basis: polyether ionophore products (lasalocid, maduramicin, salinomycin, monensin, narasin) and synthetic products (robenidine, decoquinate, diclazuril) as well as the combination of narasin-nicarbazin.

The combination of narasin-nicarbazin, lasalocid, decoquinate and robenidine demonstrated the highest average efficacy when considering improvement in daily weight gain versus control groups (57.4%, 50.7%, 45.5% and 42.8% improvement respectively). Amongst them lasalocid demonstrated the most consistent results (SD 19.6) (Graph.1).

*E. acervulina* strains showed highest sensitivity to decoquinate, followed by the combination of narasin-nicarbazin and robenidine. *E. maxima* strains were most sensitive to lasalocid. *E. tenella* strains showed highest sensitivity to decoquinate, followed by lasalocid and narasin-nicarbazin.

The monovalent ionophore products (salinomycin, monensin, narasin) and the monovalent glycoside ionophore maduramicin generally showed lower efficacy. In terms of average improvement, monensin and salinomycin were slightly better than maduramicin and narasin. The lower efficacy of the monovalent ionophores could be related to overuse, as well as to the cross-resistance amongst them. On the other hand, the divalent ionophore lasalocid showed markedly better efficacy. The synthetic product diclazuril provided the lowest average efficacy.

All the products showed variable results in the tests with the different isolates, depending on the particular isolate’s sensitivity. The ionophore products in general were more consistent in their efficacy, while the synthetic products showed more variations. This was probably due to the different patterns of the resistance development for both ionophore and synthetic products. Of course, these results are averages and cannot simply be used for generalized advice.

References


