Rotation programmes for coccidiosis control

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Improvements in the performance of commercially reared poultry have been made in recent years and it is doubtful that this could have occurred without the successful control of coccidiosis. Coccidiosis is caused by protozoan parasites of the genus Eimeria that develop in the intestine and can cause poor growth, impaired feed conversion and sometimes death.

Eradication has proved impossible and the parasites are found in most commercial broiler houses. In most countries the preferred method for control involves incorporating an anticoccidial drug in the feed and many compounds have been introduced for this purpose.

Unfortunately, the continuous use of the same drug can result in the acquisition of resistance by the parasite and this will result in loss of efficacy. This article discusses the important role that anticoccidial drugs, used in shuttle and rotation programmes, play in the control of coccidiosis in poultry.

Anticoccidial drugs

The chemical and trade names of some of the most commonly used anticoccidial drugs that are incorporated in poultry feeds are listed in Table 1.

Two categories of drug are employed to control coccidiosis in poultry, ionophorous compounds or molecules (ionophores) and synthetic agents (also known as chemicals).

The former include three classes of ionophores:

- Monovalent ionophores, such as salinomycin, monensin, and narasin.
- Monovalent glycosides ionophores such as maduramicin and semduramicin.
- Divalent ionophore lasalocid.

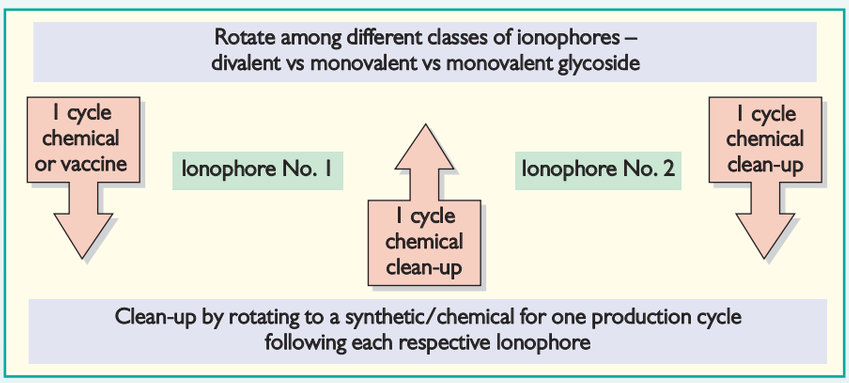
Ionophores interfere with the passage of ions across the cell membrane and, thereby, cause death of the parasite. They share a common mode of action and if resistance develops to one ionophore then it will also be apparent to the others, mainly between the ionophores of the same class (cross resistance).

Synthetic drugs have an entirely different action and inhibit a variety of different biochemical pathways; if resistance develops then it will not be shared with an ionophore or synthetic drug of different type. This provides the rational basis for the use of synthetic drugs and ionophores in rotation programmes.

Another important difference between ionophores and synthetic drugs is the manner in which they destroy parasites. The action of ionophores is directed against sporozoites, the stage of the life cycle present in the gut lumen, before they penetrate a host cell, whereas, chemical coccidiostats destroy intracellular stages once they have invaded host cells and are undergoing development in the intestine. It is important, therefore, that ionophores are present in the gut at all times at the concentration recommended by the manufacturer.

Management practices that restrict feed intake are undesirable because they may result in drug levels lower than those necessary for maximum efficacy.

Fig. 1. Anticoccidial rotation example for broilers.



Chemical name	Trade name
IONOPHORE	
Lasalocid	Avatec
Maduramicin	Cygro
Salinomycin	Biocox, Salinomax, Sacox
Monensin	Coban, Elancoban
Narasin	Monteban
Semduramicin	Aviax
SYNTHETIC	
Robenidine	Robenz, Cycostat
Decoquinate	Deccox
Dinitolmide	Zoamix
Amprolium	Amprol
Clopidol	Coyden
Diclazuril	Clinacox
Halofuginone	Stenorol
Nicarbazin	Nicarb

Table 1. Anticoccidial drugs used in poultry feeds.

How drugs are used

Three types of drug programme are used by the broiler industry. The first involves use of the same drug in the feed of a single flock (single drug programme). The prolonged use of a single drug programme will result in a gradual decline in efficacy because of the selection of resistant strains. This decline took several years in the case of the ionophores but for some synthetic drugs, such as the quinolones and arprinocid, this occurred rapidly leading in some cases to their withdrawal from the market. Drugs vary in the rate at which resistance develops but eventually prolonged use has resulted in resistance to all the drugs that have been introduced.

The second type of programme is the so-called 'shuttle' in which two or more drugs are used in different feeds in the same flock. Shuttle programmes commonly involve incorporating a synthetic drug in the starter feed followed by an ionophore in the grower but the use of two synthetic drugs with different modes of action, or ionophore followed by chemical has been employed. The advantage perceived for a shuttle programme is that any resistance

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that develops to one drug may be eliminated by the other drug and vice versa.

Although shuttle programmes do not prevent resistance from being acquired it is thought that they slow its development. It is important to note that it is important to ensure that the drugs used in a shuttle programme differ in their mode of action. Thus, the use of two monovalent ionophores will not prevent the development of resistance.

The third type of drug programme involves alternation of different drugs in successive flocks (so called rotation programmes). Many different rotation programmes have been devised, most involving alternation of a synthetic drug employed in the starter and/or grower feed of one flock followed by an ionophore in the subsequent flock. The principal involved in rotation programmes is similar to the shuttle programme in that the use of drugs with different modes of action will help the elimination of any strains that may be resistant to ionophores, while it has been demonstrated that resting a class of drugs helps restoring the efficacy of the parasites to that drug.

Choice of drug

Choice of drug for use in a rotation programme can be difficult since resistant strains may already be present; unfortunately, there are no easy methods to determine which drugs are most appropriate. However, the more frequently a particular compound has been used in the past the more likely that some resistance has been acquired.

Some drugs, such as the already mentioned quinolones and arprinocid, should not be used because experimental studies have shown that resistance to them develops extremely rapidly. In the case of other synthetic drugs resistance can also develop and, therefore, use of a given chemical should be restricted to no more than two flocks in a given year. This will preserve their efficacy and help reduce the incidence of any strains resistant to ionophores.

Practical programmes

An example of a practical rotation programme employed successfully in the USA is shown in Fig. 1. This makes use of the synthetic drug nicarbazin and various ionophores. Unfortunately, nicarbazin cannot be used during the hot summer months for reasons of metabolic toxicity and so its use is confined to the winter and early spring in the starter feeds of shuttle programmes.

This disadvantage does not apply to other synthetic drugs that can be used at any time of year. In the USA broilers are often reared for several flocks on reused litter and chemical coccidiostats are often used following 'clean-out' in spring.

This has the further advantage that any resistant strains that may be present are removed with the old litter. Rotation programmes should be devised that take account of local conditions and husbandry practices and this will vary depending upon climatic conditions and other environmental factors.

It is important, however, that programmes be sustained since the goal is to achieve long term improvements in the control of coccidiosis.

Conclusion

Coccidiosis is a parasitic infection that in the past caused catastrophic losses to the poultry industry. Today, thanks to the discovery of many effective drugs, the disease is well controlled.

We should be on our guard, however, because the causative organisms are still present in most poultry flocks and have proved to be very adaptable eventually acquiring resistance to widely used drugs.

Unfortunately, in recent years few new compounds have been discovered and, therefore, it is important that we utilise control programmes that preserve the efficacy of currently available anticoccidial drugs.

This may be achieved by a combination of good management plus the adoption of practical rotation programmes involving synthetic drugs and ionophores. ■

Research sponsored by Alpharma Animal Health