



Coccivac®-B Alone or in Rotation with Clinacox™ Renews Salinomycin Efficacy Against Resistant Coccidia

Clinacox™ (diclazuril) is an effective chemical anticoccidial introduced to the US broiler market in the year 2000. Diclazuril's efficacy against oocyst production in sensitive coccidial strains is so complete that the product can be used to significantly reduce oocyst levels in broiler houses. This "clean up" effect reduces challenge levels to subsequent flocks and improves the performance of the next chemical or ionophore in rotation.

Vaccination is another way to improve subsequent in-feed anticoccidial efficacy. Dr. David Chapman at the University of Arkansas has demonstrated that monensin-

resistant coccidial strains can be replaced or out-competed by the drug-sensitive strains present in Coccivac®-B, resulting in renewed monensin efficacy against the coccidial population (Chapman, 1994). This original work was recently corroborated in field studies undertaken by Dr. Harry Danforth at the USDA in Beltsville, Maryland (Schering-Plough *Technical Service Bulletins* #356, #357).

In 2001, Dr. Chapman conducted a long-term study that examined the impact of several rotation programs on salinomycin-resistant coccidial strains. He allowed one group to have complete rest from all anticoccidials for four consecutive flocks. In other groups of birds, he examined the strategy of first using Clinacox for two flocks to reduce the overall oocyst population within a facility, followed by repopulation of the facility with drug-sensitive strains by vaccinating with Coccivac-B for two flocks. Dr. Chapman compared a straight salinomycin program, three different Clinacox shuttle programs rotating to Coccivac-B and a straight Coccivac-B program.

Key Points

- Complete rest from anticoccidials for four consecutive flocks resulted in improved, but not restored, sensitivity to salinomycin.
- All three Clinacox™ shuttles (Clinacox/salinomycin, salinomycin/Clinacox or Clinacox/Clinacox) followed by Coccivac®-B resulted in nearly complete restoration of sensitivity to
- Coccivac-B used alone for four consecutive flocks also resulted in nearly complete restoration of sensitivity to salinomycin.

Study Design

Four consecutive broiler flocks were grown to 49 days of age with 2 weeks down time between flocks. The flocks were placed from February to October 2001 at the University of Arkansas, Department of Poultry Science, Research Farm. The trial required using four rows of 12 pens in a concrete-floored facility. Litter in the pens was infected with an oocyst population representative of broiler farms

Table 1: Study design and treatment groups

Treatment Number	Flock Number			
	1	2	3	4
	Starter feed/ Grower feed	Starter feed/ Grower feed	Starter feed/ Grower feed	Starter feed/ Grower feed
1	None	None	None	None
2	Salinomycin/ Salinomycin	Salinomycin/ Salinomycin	Salinomycin/ Salinomycin	Salinomycin/ Salinomycin
3	Clinacox/ Salinomycin	Clinacox/ Salinomycin	Coccivac-B	Coccivac-B
4	Salinomycin/ Clinacox	Salinomycin/ Clinacox	Coccivac-B	Coccivac-B
5	Clinacox/Clinacox	Clinacox/Clinacox	Coccivac-B	Coccivac-B
6	Coccivac-B	Coccivac-B	Coccivac-B	Coccivac-B

Notes:

Salinomycin: All treatments also contained 3-Nitro and BMD.

Clinacox: All treatments contained BMD.

Coccivac-B: Feed contained BMD as sole drug.

that have used salinomycin heavily for several years. Fifty birds were placed per pen for each of the four consecutive “flocks.”

The study arranged treatments as shown in Table 1.

Sensitivity Test

Litter samples were collected from the fourth consecutive flock of birds at 28 days of age. Oocysts were harvested from these samples according to standard laboratory procedures and sporulated in potassium dichromate.

In addition, 10-day-old birds that had been reared in the absence of infection were randomly allocated to 48 cages in Petersime battery units (6 birds/cage). Twenty-four cages were supplied with starter feed containing salinomycin supplemented with 3-Nitro (roxarsone) and BMD (bacitracin methylene disalicylate). The remaining 24 cages were provided with BMD only and served as controls. Four medicated and four control cages were allocated to the six treatments (four replicates) as indicated in Table 2. Three days after birds were placed in the cages, they were inoculated with 500 oocysts

obtained from the litter of the respective treatments. Feces were collected from each cage from 5 to 8 days later and the number of oocysts present were counted.

Results

To estimate the efficacy of salinomycin, oocyst production was expressed for each treatment as a percentage from the BMD-only controls. Low oocyst production as a percentage of controls indicates that the oocysts were *sensitive* to salinomycin.

For all treatments, oocyst production was reduced by salinomycin compared to controls. Although reduced, however, there was still significant oocyst production in birds challenged with oocysts from the pens that had rested for four consecutive flocks and from the pens that had used salinomycin for four consecutive flocks. Salinomycin was not completely effective against oocysts from these pens.

In contrast, salinomycin was almost completely effective at suppressing oocyst production in birds challenged with oocysts from pens that had received Clinacox (in the

Cage Number	Treatment Number	Treatment	Cage Number	Treatment	Previous Treatment
1-4	1	Salinomycin + 3-Nitro + BMD	25-28	BMD	None
5-8	2	Salinomycin + 3-Nitro + BMD	29-32	BMD	Salinomycin
9-12	3	Salinomycin + 3-Nitro + BMD	33-36	BMD	Clinacox/ Salinomycin/ – Coccivac-B
13-16	4	Salinomycin + 3-Nitro + BMD	37-40	BMD	Salinomycin/ Clinacox – Coccivac-B
17-20	5	Salinomycin + 3-Nitro + BMD	41-44	BMD	Clinacox/ Clinacox – Coccivac-B
21-24	6	Salinomycin + 3-Nitro + BMD	45-48	BMD	Coccivac-B

Table 2: Sensitivity test design

starter, grower or both starter and grower feeds) followed by Coccivac-B. Salinomycin also was effective against isolates obtained from the treatment that had previously received Coccivac-B for four flocks.

The results are summarized in Table 3.

Conclusions and Discussion

Historically, “rest” was the only technique used to improve the efficacy of an anticoccidial under field conditions. Unfortunately, the absence of any new anticoccidials and

the increasing incidence of field resistance to existing drugs have made this time-tested strategy obsolete. Increased use of shuttle programs and rapid rotation of products has become less effective over time. Long-term use of ionophores appeared to be successful, but over the course of several years, this strategy too has resulted in the erosion of performance.

To preserve anticoccidial efficacy, a proactive role is needed. Coccivac-B used alone or in a rotation with Clinacox may improve the efficacy of salinomycin in coccidial populations

Treatment No.	Treatment (Previous Flocks) Medication	Oocysts Produced (Thousand/Bird) Medication		Oocyst Production (% of Controls)*
		Salinomycin + 3-Nitro + BMD	BMD	
1	None	400	1766	23
2	Salinomycin/Salinomycin	333	888	38
3	Clinacox/Salinomycin	211	6155	3
4	Salinomycin/Clinacox	22	689	3
5	Clinacox/Clinacox	11	869	1
6	Coccivac-B	144	3026	5

Table 3: Salinomycin efficacy as a percent of oocyst production in controls

*Lower numbers = better salinomycin efficacy.

that have lost sensitivity to the popular ionophore. Clinacox appeared to be equally effective when used in the starter or grower or as a straight program in rotation with Coccivac-B.

This study demonstrates that poultry producers now have the tools they need to help them manage the long-term effectiveness of

their anticoccidial program. Which program each producer chooses — a year-round Coccivac-B program or a rotation program using Clinacox — will depend on seasonal management concerns, program cost and broiler processing weight.