Organic acid water treatment effective in decreasing *Salmonella* colonization and horizontal transmission in broiler chickens

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The objective was to evaluate the water treatment effect of two organic acid blends on *Salmonella* (SAL) colonization and horizontal transmission in broiler chickens. In the first experiment, a total of 1080, day-old Cobb X Cobb male chicks were allocated 60/pen to each of 18 pens by blocks and divided into three treatment groups: T1, unmedicated control; T2 , 0.04%; and T3, 0.08% of an organic acid blend (OAB1; ACTIVATE® US WD MAX). In the second experiment we had similar experimental design but with only T1, unmedicated control and T2, 0.04% of the European organic acid blend (OAB2; ACTIVATE® WD MAX). In both experiments, the OABs were added to water from 0-14 days and 42-49 days. Half of the birds in each pen were orally dosed with Nalidixic acid resistant-*S. heidelberg* on Day 0 and housed with the remaining uninfected birds. Dragswabs of pens were obtained on days 0, 14 and 49 and also on day 49, *Salmonella* status of ceca was evaluated. Results showed significant reduction of SAL + dragswabs in both experiments. Similar results were found in ceca cultures. These results demonstrated that both OABs treatment significantly reduced SAL colonization, horizontal transmission and reduced environmental SAL contamination.

Keywords: organic acids; ACTIVATE WD; *Salmonella*

Introduction

Food safety is one of the top priorities in poultry production today. *Salmonella* is one of the major contributors to food-borne illnesses linked to poultry products like eggs and poultry carcasses (5,6,4). Achievable strategies for *Salmonella* reduction must involve interventions at multiple points from the farm to the table. The use of organic acids in the water (1) or in the feed (2,3) have proven to be practical and efficacious farm interventions to reduce *Salmonella* incidence and colonization in broilers.

The objective of this study was to evaluate the water treatment effect of two organic acid blends on *Salmonella* (SAL) colonization and horizontal transmission in broiler chickens.

Materials and methods

A total of one thousand eighty (1,080) and seven hundred and twenty (720), one-day-old Cobb X Cobb male chicks were used in the first and second study respectively. At each study initiation, sixty

males were allocated to each of the pens by blocks (0.77 sq. ft/ bird, stocking density). Half of the chicks (30) per pen were tagged for identification and then orally dosed with ($2.2x10^7$) Nalidixic acid resistant-*Salmonella heidelberg* on Day 0 (prior to placement). Bird weights (kg) by pen were recorded at Day 0, Day 42, and termination (Day 49). All pens had approximately 4 inches of fresh pine shavings. There were 30 birds/hanging feeder and all birds consumed feed and water *ad libitum.*

Treatments:

Experiment 1

Treatment	ACTIVATE® US WD MAX %	Days of Treatment	*Salmonella*	Pens/Trt.
T1	Nonmedicated	0	YES	6
T2	0.04%	1 to 14 and 42 to 49	YES	6
T3	0.08%	1 to 14 and 42 to 49	YES	6

Experiment 2

Treatment	ACTIVATE® WD MAX%	Days of Treatment	*Salmonella*	Pens/Trt.
T1	Nonmedicated	0	YES	6
T2	0.04%	1 to 14 and 42 to 49	YES	6

In both experiments, broiler diets were fed as crumbles (Starter feed) or as pellets (all remaining feeds – Grower and Finisher). Diets were representative of local formulations and calculated analyses met or exceeded NRC standards. All starter feeds contained 125ppm Nicarbazin, and all grower feeds contained 100 ppm Coban, and 50 ppm 3-Nitro 20. All finisher feeds were nonmedicated.

Salmonella sampling

Drag swab samples were collected from all pens on Days 0, 14, and 49 On Days 14 and 49, ten birds per pen (5 tagged and 5 nontagged) were euthanized by cervical dislocation, weighed, and the ceca aseptically removed and placed into sterile plastic sampling bags for salmonella enumeration. For the isolation and identification of *Salmonella*, 1 µl loop of the cecal extract in tetrathionate brilliant green broth was streaked onto XLT4 and BGN agar plates containing nalidixic acid and incubated at 37°C overnight. The H_2S-positive isolated colonies were then placed onto triple sugar iron slants and incubated at 37°C overnight. Suspect *Salmonella* colonies were then confirmed with poly O *Salmonella*-specific antiserum. All *Salmonella* was stored for PCR comparison to the challenge strain

Results and Discussion

Experiment 1. Results from the cultured ceca at day 49 (Figure 1) showed that on day 49, treatments with ACTIVATE® US WD MAX significantly ($P<0.05$) reduced the horizontal spread of *Salmonella* from the infected seeders (tagged) to their penmates (nontagged) as evidenced from $\log_{10}$ 1.3 and 1.8 for tagged seeders and 0.7 for penmates. Additional evidence of this reduced level of *Salmonella* in the environment of the treated pens is the lower percent positive dragswabs; 67% for nonmedicated vs. 17% and 33% for the 0.04% and 0.8% treatments with ACTIVATE® US WD MAX, respectively

Figure 1

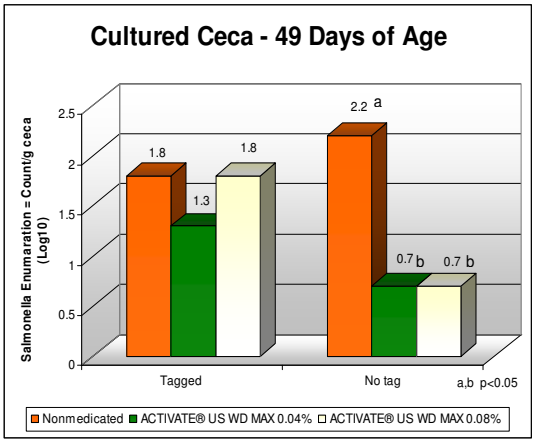
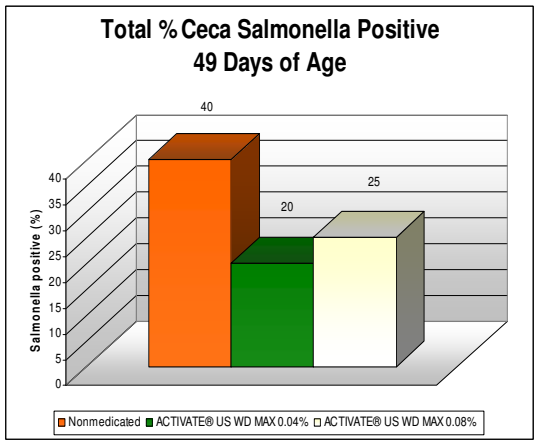


Figure 2



This study clearly demonstrated that lower *Salmonella* levels in the litter (dragswabs) resulted in lower levels in the ceca of uninfected birds. It also demonstrated up to a 50% reduction in the total percentage of ceca *Salmonella* positive at 49 days (Figure 2).Thus ACTIVATE® US WD MAX nutritional organic acid blend successfully interrupted the infection cycle of Salmonella in uninfected chickens which significantly reduced the number of Salmonella positive chickens at the end of the trial.

Experiment 2. On Day 14th drag swabs showed 100% positives. This demonstrates that the *Salmonella* model used was very successful and that at least some of the tagged / orally challenged birds in each pen were shedding S*almonella*. This gave the non-tagged/ not orally challenged birds in all pens an even chance of picking up the *Salmonella* directly from the litter. On Day 49 Drag swabs showed that 50% of the litter in the non-treated pens still had a detectable level of *Salmonella* . For all treated pens (ACTIVATE® WD MAX) the amount of positive drag swabs was 0% (Figure 3). The lack of any presence of *Salmonella* in the litter of the treated pens was due to treatment effect and not due to *Salmonella* dying off during the course of the study. This result reinforce the evidence from the previous study that organic acids can reduce the level of *Salmonella* in the litter.

A significantly lower number of positive, tagged, and naïve non-tagged birds were found in the treatment pen birds than the non-treatment birds, resulting in a significantly lower total percent of ceca positive on Day 14 (Fig. 4) and 49 (17% vs 5%, $p<0.05$)**.** The overall reduction in numbers of positives was over 70% with ACTIVATE® WD MAX treatment. The lower number of total percentage of ceca *Salmonella* positives confirms the previous study's findings.

Figure 3

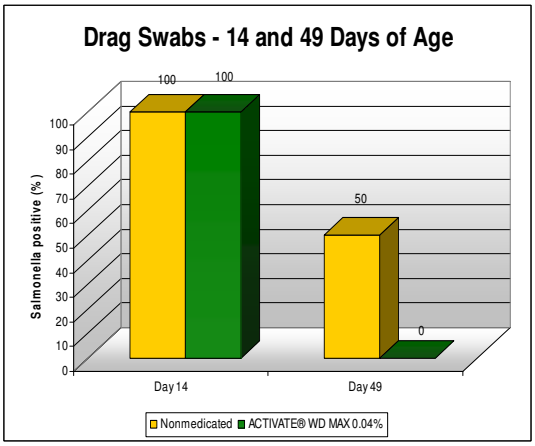
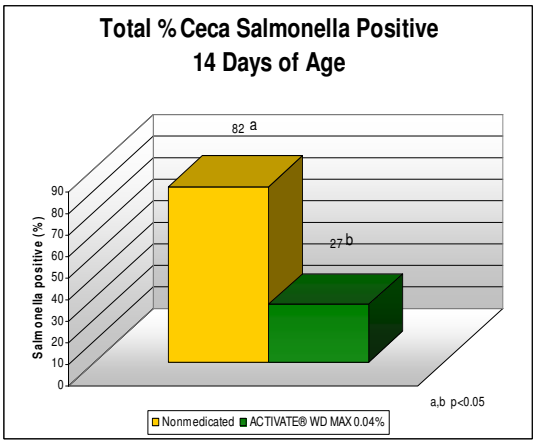


Figure 4



This study confirmed that inclusion of ACTIVATE® WD MAX in the drinking water resulted in lower *Salmonella* levels in the litter (dragswabs) and lower levels in the ceca by interrupting the infection cycle of *Salmonella* in uninfected birds.

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