Chorine Dioxide (ClO_2) Studies in Young Turkeys

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Objectives of paper

(1) to review drinking water sanitation and the role it has in turkey pathogen transmission.
(2) to review 3 studies on ClO_2 and to provide some objective advice on using ClO_2 as a water sanitizer in turkey drinking water.
(3) to generate discussions on water sanitizers and specific discussions on ClO_2.

Review: The Importance of Using Sanitizers in Turkey Drinking Water Delivery Systems

Providing a quality drinking water source in the brooder house cannot be overstated. This drinking water should be free of debris, free of pathogens, and of course, palatable to young turkeys. Remember, if young turkeys won't drink the water, regardless of why, there will be a dramatic effect on livability and weight gain and feed conversion throughout the whole production cycle.

One of the unique challenges that the turkey industry faces in providing "quality" water to young brooder house turkeys is the common use of open-type drinkers. The bell (plassson) type drinker can adequately provide the amount of water that young turkeys need in order to grow. However, this type of system has a number of disadvantages. The most important feature of this type of drinker is that in order to provide "fresh" water to young turkeys, it is time consuming and very labor intensive to keep drinkers visibly free of debris (litter, fecal material, feathers). Although, it is often what we don't see that can cause livability and productivity problems in the brooder house and grow-out. "What we don't see", is what has generated investigations into ClO_2 as an alternative to free Cl_2 as a water sanitizer.

Disease-causing organisms (pathogens) can come from a variety of sources and grow under a variety of conditions. If wells are not checked regularly, older wells can become contaminated by runoff waters that can contain decaying organic debris, pesticides, fecal wastes to name a few. But not only do we have to be concerned about the source of the water (the well). The pipes in the house that supply the drinkers can be a source of pathogens to young turkeys. When waterlines are not disinfected properly (between flocks), the biofilm within that pipe, made up of a polysaccharide matrix (e.g. nutrient source), can build-up. Once established, pathogens such as *Salmonella*, *Campylobacter*, *E. coli*, and *Bordetella* species are readily propagated. If wells, waterlines and drinkers are not properly disinfected

(between flocks), biofilm build-up may also serve to establish pathogen resistance to common water disinfectants such as sodium hypochlorite (free Cl_2).

Sodium hypochlorite (common household bleach) is a common poultry water sanitizer. One of the obvious benefits of chorine is that it is cheap and easily applied in poultry drinking water systems. However, there are a number of limitations that need to be considered. These include; a narrow pH range for effective biocidal activity, reactivity with ammonia or ammonia containing compounds, its readiness to form acids and salts which may be particularly corrosive on equipment, and the potential for pathogens to develop resistance.

ClO_2 is a strong oxidizing agent, often generated from sodium chlorite or sodium chlorate. It is being used in a number of industries such as disinfectant and sanitizer in human drinking water systems, a wash water for fruit and vegetables, poultry chiller wash water to name just a few.

At this time, there is limited information regarding the use of ClO_2 as a poultry drinking water sanitizer. Even more importantly, there is little information regarding the biocidal activity of this agent under field type conditions, and any growth or immune enhancement activity it may have.

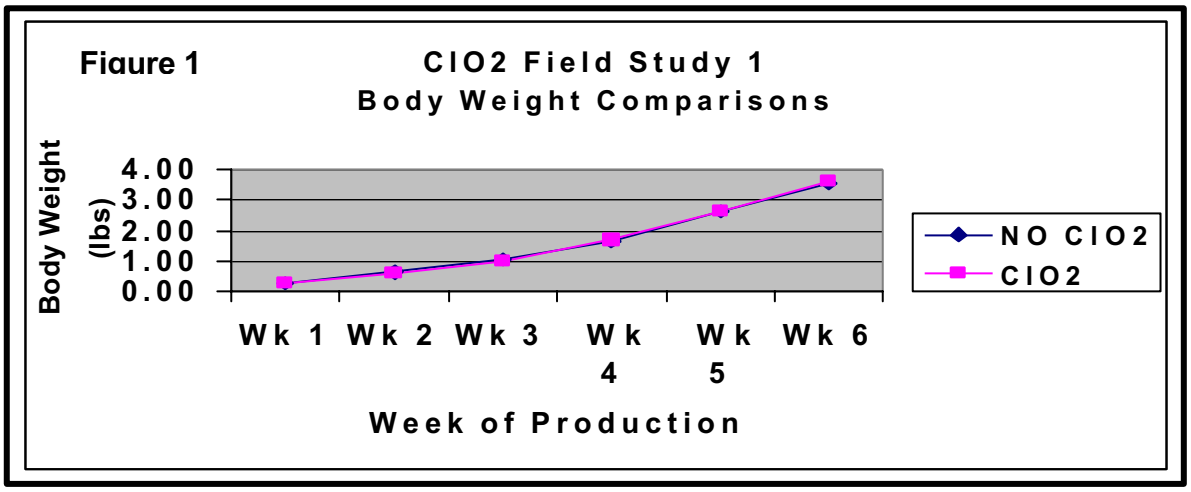
ClO_2 studies at a glance

Field Study 1

A 6-week field study using ClO_2 as a drinking water sanitizer was completed in the summer of 2002 on a commercial turkey brooder farm in Nbrth Carolina. One objective of the study was to compare the growth and livability of young turkey poults from 0-6 weeks of age and correlate it with ClO_2 in the water as a sanitizer.

Approximately 16, 300 1 day-old tom poults were placed in mirror fashion (with respect to breeder flock), into 1 of 2 houses. House 1 contained ClO_2 as a water sanitizer with a target of 0.3 ppm. House 2 contained a traditional water sanitizer (common household bleach) with a target of approximately 3.0 ppm (end drinker).

Figure 1 shows the weekly body weights the turkeys achieved during this trial.



At six weeks of age, turkeys receiving ClO_2 as a water sanitizer weighed 3.62 lbs, compared to birds not receiving ClO_2 as a water sanitizer, which weighed 3.53 pounds. There is negligible difference between the two groups of birds. However, birds receiving the ClO_2 treatment gained 1.03 pounds in week 6, compared to 0.90 pounds in birds not receiving the ClO_2. When considering livability between the treatments, birds not receiving ClO_2 had only a slightly better livability 97.86 % compared to birds receiving ClO_2 97.63 %. Overall, in this study, ClO_2 did not appear to have a major impact on the growth and livability in young tom turkeys.

Like many field studies, there were a number of confounding factors that may have contributed to differences not detected. Structural differences between houses (available square feet, ventilation), equipment such as feeders, drinkers, brooders), and disease management differences (antibiotic treatments) made it difficult to equally compare the two treatments. However, a number of questions were raised at the conclusion of the study that enabled us to rethink our design of ClO_2 studies. Foremost among those questions were how to more accurately measure ClO_2, and more precisely sample for poult and drinking water differences between water treatments.

Controlled Study

In the spring of 2003, a second study was initiated at our isolation facilities, on the campus of the College of Veterinary Medicine, NCSU, to investigate the effects of low levels provided in the drinking water of young turkey poults 0-3 weeks of age. The objectives of this study were: (1) to determine the level of ClO_2 that poults would accept in their drinking water given four levels of (0.0, 1.0, 5.0 and 10.0 ppm), and, (2) to determine, at what level of, if any, would depress common production measures (growth and livability), and weights of majors organs,

Sixty one-day old "Nicholas" hens were randomly allocated to 1 of 4 glove port isolators with 15 birds placed in each isolator to begin the experiment. Each Isolator contained 1 of 4 levels of ClO_2 in de-ionized water (0.0, 1.0, 5.0, and 10.0 ppm). All birds were provided a starter ration *ad libitum* and standard brooding environmental conditions were followed. Data was analyzed using Analysis of Variance, using least significant differences.

In the following figures, treatment group 1 is disregarded due to problems within this treatment group on day 3 of the trial. Birds from this group became water soaked chilled. Though none of the birds died, this group is not considered in any final analysis.

Figure 2 demonstrates how good treatments were prepared and measured over the trial period. Generally, as the graph indicates, larger targets were easier to hit, coming closest to target levels in the 10.0 ppm group (99%), followed by 5.0 ppm

group (96 %) and then the 1.0 ppm group where we had a 95 % accuracy over the three periods.

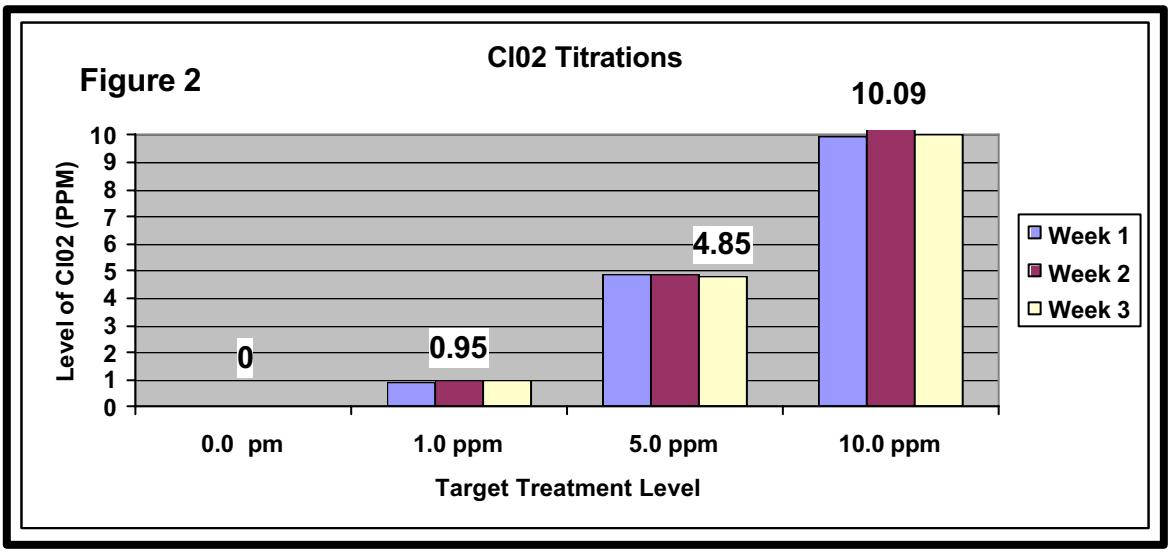
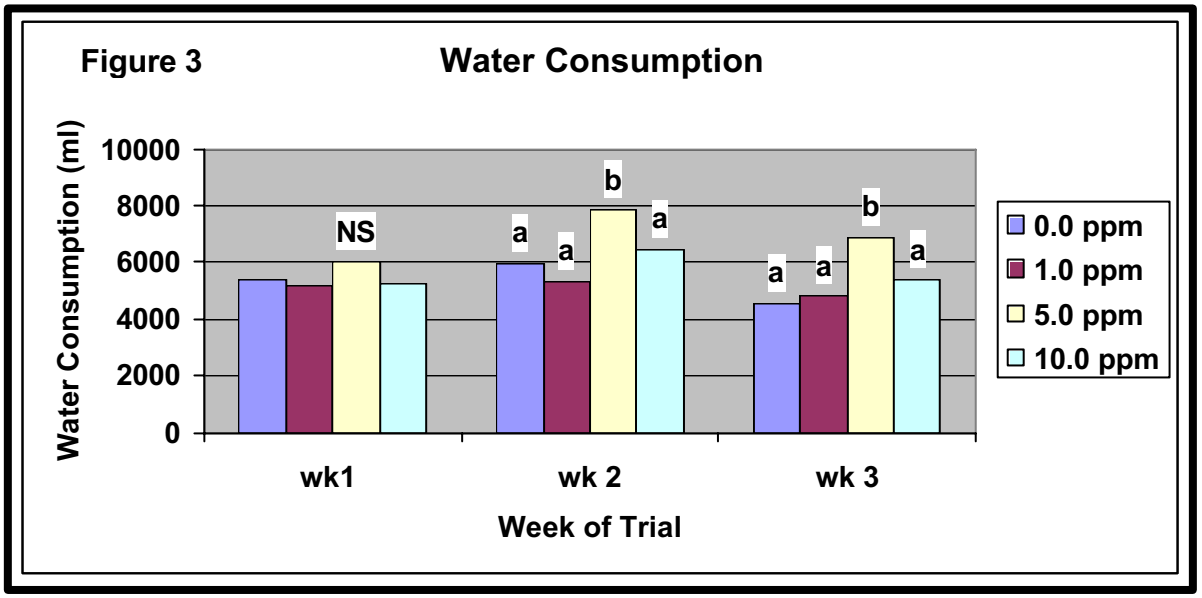


Figure 3 shows cumulative water consumption, by week, in birds receiving water treatments. No significant differences were observed between treatment groups in week 1[1]. In weeks 2 & 3, differences in water consumption were observed between birds not provided any, and those that received 5.0 ppm. Significant differences were also observed between birds receiving 5.0 ppm and 10.00 ppm respectively.

Figure 4 shows body weights achieved in all treatment groups during this trial.
No significant differences observed between treatment groups at placement, week 1, and week 2. However, in week 3, significant differences were observed between birds receiving 0.0 ppm and 5.0 ppm .



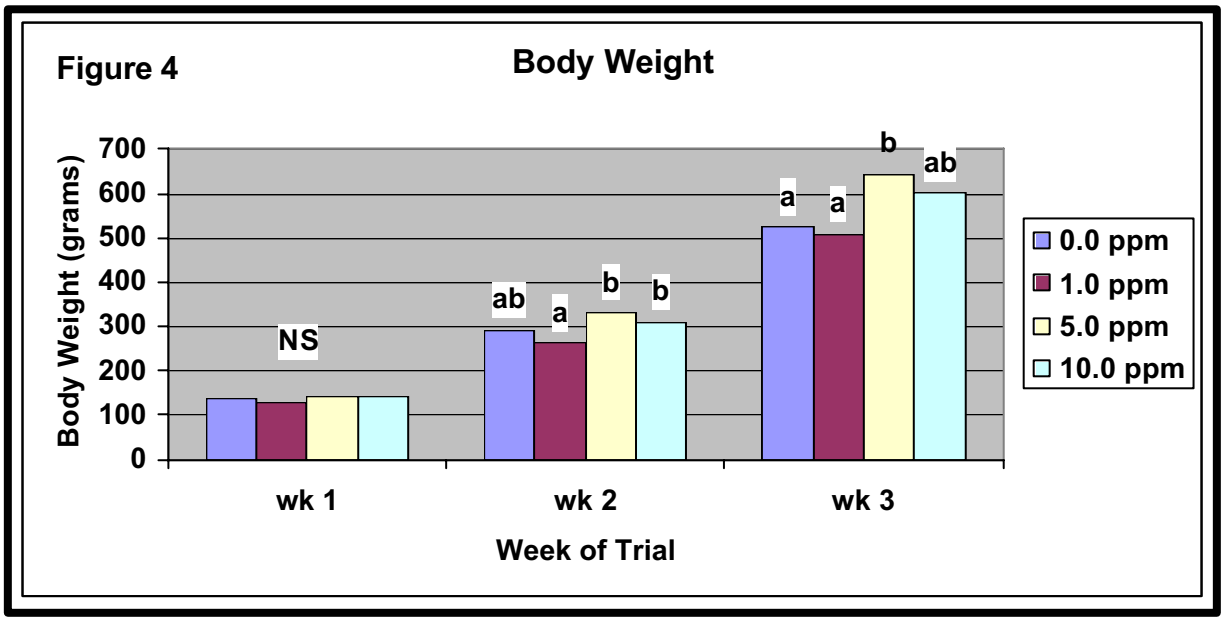


Figure 5 shows feed conversions ratios by week, for all treatment groups. In weeks 1 and 3, no significant differences were observed between treatment groups. However, differences were detected in week 2, between groups not provided any ClO_2 in their drinking water and those birds receiving 5.0 ppm .

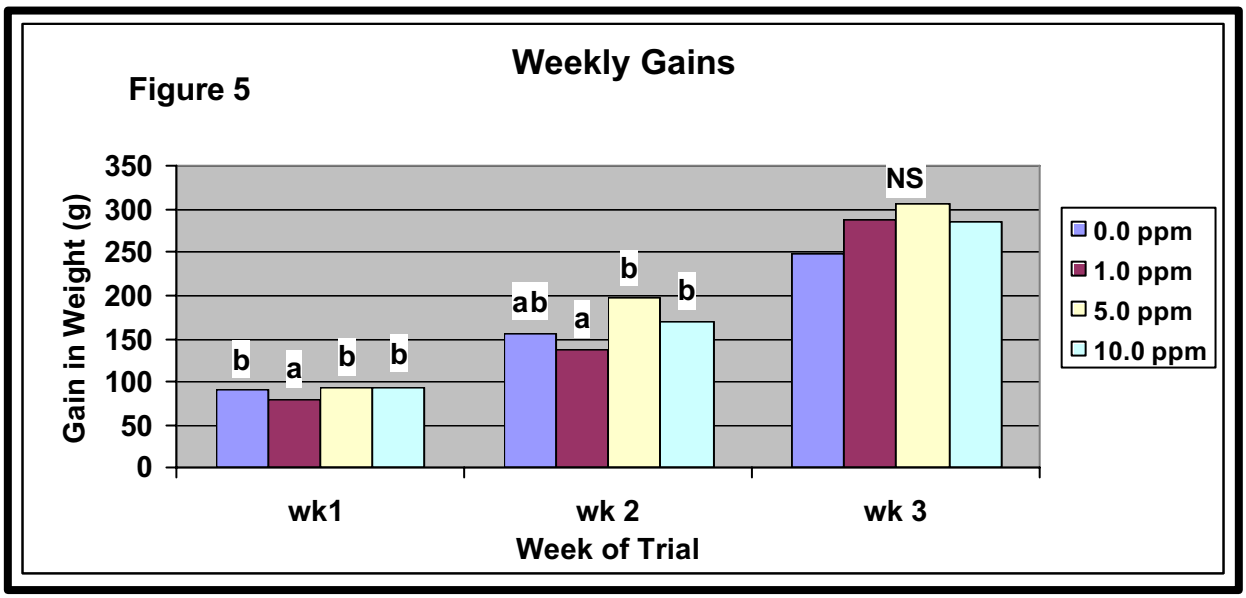
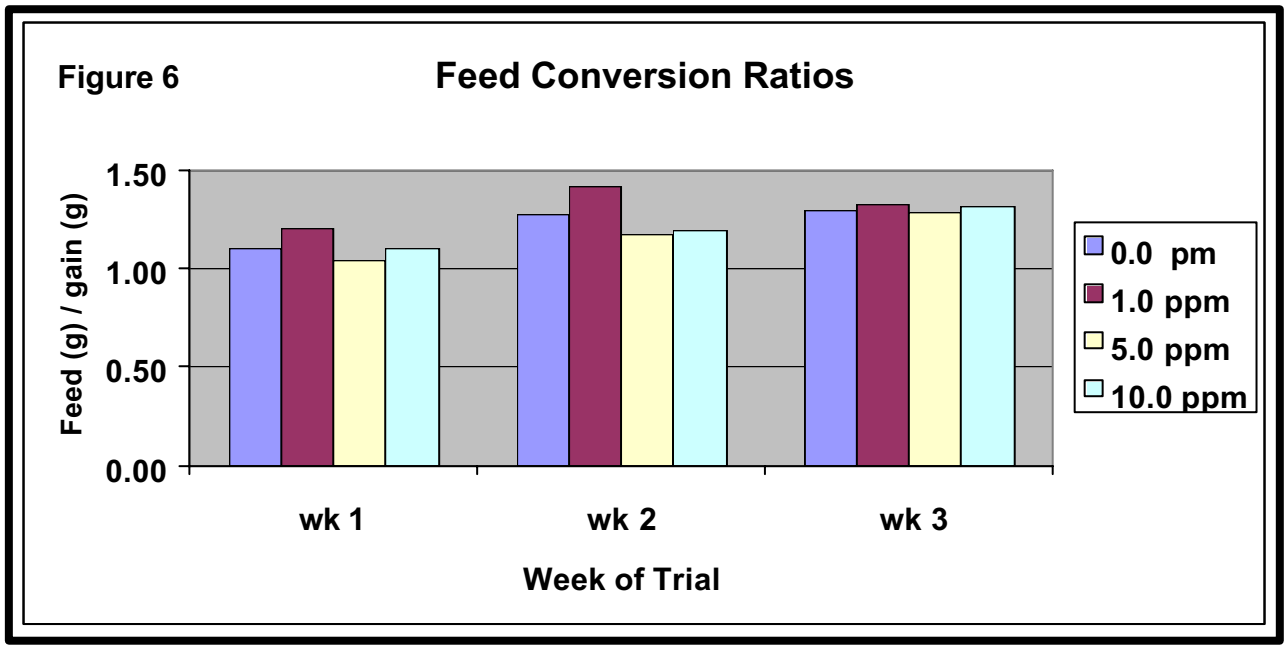


Figure 6 demonstrates feed conversion ratios for all groups over the three-week trial period. Birds receiving 5.0 ppm ClO_2 consistently had a lower feed conversion than any other treatment group, throughout the trial period. The second best feed conversion ratio, were birds provided 10.0 ppm, and, and birds not provided and in their drinking water had better FCR than birds provided 1.0 ppm over the 3 weeks.



Birds were necropsied weekly for gross lesions associated with treatment, and weights of major organs. No significant differences between treatment groups were observed when considering, gross or incidental findings, liver weight[2], bursa[2], thymus[2], spleen[2].

Results from this controlled study indicate that (1) measuring ClO_2 can be easily done in a research environment, (2) young turkey poults did not refuse ClO_2 as high as 10.0 ppm in their drinking water, and, (3) evidence from this study suggest that 5.0 ppm may be an optimum inclusion rate as a water sanitizer.

Finally, a second field study (Field Study 2) was completed in June of 2003 at a commercial turkey brooding farm in North Carolina. Results from this study comparing free chlorine (Cl_2-common household bleach) and ClO_2, at the level of the drinker are being analyzed.

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[2] As a percentage of body weight

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