**Introduction**

Many pork producers accept that the standards for human drinking water should equally apply to the water that pigs consume but many in the industry are still far below this level and profits often suffer as a result.

The subject of this paper is AQUATIZE®, a unique animal drinking water disinfectant that can reduce the problems of contaminated water for pigs and raise the quality of their drinking water.

All animals, including humans, are capable of suffering the ill effects of drinking poorly disinfected water. The stomach problems caused on vacation to a country with inadequate public water filtration/disinfection is enough to convince most people of this fact. For all animals --- including humans and pigs, two animals with similar biochemistries --- drinking poorly sanitized water often results in a reduction of appetite, plummeting health, and reduced weight gain. And for people who raise production animals, this can be devastating.

Considering that pigs drink 2-3 times more than they eat, it is surprising that many swine producers often neglect treating drinking water thoroughly. Their focus is usually on feed due to its high cost and because of the myriad problems associated with feed; e.g., the presence of toxins and pathogens that can be transferred to the animals from it. However, water is perhaps as vitally important to maintaining healthy animals and increasing profits as feed. As our awareness of the importance of treating drinking water increases, more water disinfectants are coming onto the market. Some of these can more effectively kill pathogens than older, less expensive disinfectants on the market.

To reduce costs, many producers may be utilizing inefficient substances/procedures to avoid contamination by waterborne pathogenic microorganisms. Water is an excellent source for disease transmission, especially in swine. Although consumer and government regulatory attention tends to focus on *E. coli* and *Salmonella*, a wide range of disease-causing pathogens are transmitted through drinking water. And in areas where many animal producers use the same water supply, the consequences of water contamination can be disastrous.

Typically, livestock producers use acidifiers, sodium hypochlorite (bleach), chlorine dioxide or hydrogen peroxide to combat pathogens in water along with other more harsh chemical methods to combat biofilm coating the water lines and kill unattached pathogens in water. However, each of these has inherent problems in effectiveness. Bleach and chlorine dioxide are the most commonly used water disinfectants, and although they are inexpensive, in order to effectively kill pathogens in contaminated water, the concentration of each of these disinfecting agents must be raised to a point where the disinfectant may actually interfere with performance of the animals or the animal may die if the concentrations are too high. Chlorine dioxide is an efficient disinfectant, but also dangerous to handle and producers risk workers’ safety by using it in farm situations. The need for a stabilized, non-toxic water disinfectant such as AQUATIZE® is essential.
AQUATIZE® is the result of more than a decade of R&D which has produced unique combinations of two oxyhalogens, sodium chlorite, sodium chlorate, plus several other substances that act as stabilizers. Several scientific studies [add references at the end] have indicated that AQUATIZE® is an effective and powerful disinfectant for use against waterborne pathogens. The product can be stored for years without loss of activity, and when added to the animal drinking water, it kills a wide spectrum of bacterial pathogens, [shouldn’t we list the 11 species here?] even at very low concentrations. AQUATIZE® does not appear to pose any threat to the environment (if used at the EPA recommended dosages), to farm workers or the animals that consume it. In addition, regular use of AQUATIZE® in the water lines prevents the build-up of biofilm and will actually dislodge existing biofilm after treated water passes through the lines; the time frame for dislodging was two to three weeks at pig farms.

Testing in Pigs

Several studies have been done in pigs demonstrating the effectiveness of AQUATIZE® over household bleach (sodium hypochlorite) or other less expensive water disinfectants. A comparative study in Asia of Chlorine Dioxide, AQUATIZE, and Untreated Control nursery-age pigs revealed improvements in Average Daily Gain (ADG) and Feed Conversion (F/G) of 7.9% and 5.9%, respectively, and a nursery pen trial at North Carolina State that compared AQUATIZE to Untreated Control revealed improvements in ADG and F/G of 5.17% and 7.06%, respectively.

To confirm these remarkable observations in a detailed scientific pen trial the study described below was conducted by Dr. James McNaughton of the PARC Institute in nursery pigs severely challenged with pathogenic E. coli and Salmonella. Different doses of AQUATIZE® and sodium hypochlorite were compared in the test.

Young pigs, at an average of 13.2 pounds each, were obtained from a large commercial pork production company and were infected per os with 1 million CFU of E. coli and 20,000 CFU of Salmonella per pig. 10 pens of 6 males per pen were placed in each treatment group. The pigs were matched for weight. The length of the test was 35 days. Below are the six treatment groups:

- T1: Infected Control Group (E. coli and Salmonella)
- T2: Uninfected Control Group
- T3: Infected with E. coli and Salmonella plus given water with 1:2000 AQUATIZE®
- T4: Infected with E. coli and Salmonella plus given water with 1:5000 AQUATIZE®
- T5: Infected with E. coli and Salmonella plus given water with 1:2000 AQUATIZE® for the first two weeks, then AQUATIZE® at 1:5000 the third week.
- T6: Infected with E. coli and Salmonella plus given water with 3 ppm sodium hypochlorite (bleach).
As shown in Figure 1, pigs that consumed water treated with AQUATIZE® suffered far less mortality than pigs that drank water treated with sodium hypochlorite. Mortality in the AQUATIZE® group ranged from 5% to 8% vs. 13.33% in the bleach group. Infected and untreated Controls (T1) suffered nearly 15% mortality, but uninfected Control pigs (T2) exhibited only 1.8% mortality. Confirming the earlier observations from the preliminary trials conducted in Asia and the USA, pigs receiving AQUATIZE® weighed an average of 3.9 lbs (12.77%) more than pigs receiving the bleach-treated water. In marked contrast, AQUATIZE® groups of pigs weighed an average of only 1.09 lbs less (2.84%) than uninfected Control pigs (T2), but the AQUATIZE® groups averaged a full 4.9 lbs (17.02%) more weight than infected, untreated Controls (T1). Mortality in the three AQUATIZE® groups varied as a function of the dosage of the product tested with the least mortality observed at the highest dose of product used.

Figure 1:

![Mortality & Weight Gain with Aquatize® vs. Bleach in Infected Pigs](image)

While the mortality and weight data are impressive, equally interesting improvements in Feed Conversion Ratio (FCR) were obtained with all doses of AQUATIZE® tested (figure 2). FCR in the highest dose of AQUATIZE® tested (T3) was statistically equal to the uninfected, untreated Control group (T2). However, 3-4 ppm sodium hypochlorite in the drinking water of group T6 was not improved statistically over the FCR of the infected and untreated Control group (T1). Thus, treating the drinking water with bleach proved to be almost worthless in this study, with an FCR of 1.912 compared to the infected, untreated control at 1.938. All of the doses of AQUATIZE® that were tested improved the FCR in spite of the purposeful infection of the pigs with *E. coli* and *Salmonella*. The recommended dose of AQUATIZE® (T5) improved F/G by 5.31% over infected, untreated Controls (T1), and were 4.0% better than the bleach group (T6).

Figure 2:
Many producers use sodium hypochlorite to treat the drinking water of pigs and poultry, and that decision appears to be determined primarily by the low cost of the product. However, if one takes into consideration the practical improvements that can be attributed to the sodium hypochlorite, then the cost of the product is huge as it is not easy to sell dead or sickly, underweight animals.

After the positive results were observed in the scientifically designed nursery pig trial, we collaborated with a large pork production company to conduct two nursery trials, one in the springtime and one in the wintertime. None of these pigs were purposefully infected with any pathogens. A large number of pigs in the commercial production program was dedicated to the trials. One half of the pigs received 3-4 ppm sodium hypochlorite-treated water and the other half received AQUATIZE-treated water, diluted 1:2000 for the first two weeks and then 1:5000 for the last 3 weeks of the trials. Unfortunately, during the course of the trials we learned that the company did not routinely cleanse the water lines between growth periods and consequently during the course of both trials the water lines in the AQUATIZE groups began to release sludge about 2 to 3 weeks into the trial. We do not know if this influenced the trial, but the pigs did not like to drink the sludge.

The parameters and the test results of the two commercial nursery pig trials are shown below in Table 1. The total number of pigs in each group were approximately identical and at the end of the two studies, the AQUATIZE groups had a slightly better livability, but the small difference was not statistically significantly different. However, as is quite clear from the overall results, pigs that received AQUATIZE in their drinking water weighed > 2 lbs (> 4%) more than the Control pigs, p <= 0.245. Also, feed conversion of the AQUATIZE pigs was improved 2.58% (1.745 vs. 1.70) over the Control pigs, p <= 0.156. Equally impressive was the observation that no medication costs were
reported for the pigs on AQUATIZE®, but an average of $0.137/pig of medication costs were absorbed by the Control pigs on the bleach water-treatment program.

Taken together, the improvements in weight gain, feed conversion and lower medication costs combined with the fact that more pigs in the AQUATIZE® group survived the nursery stage of production can be interpreted to mean that AQUATIZE® is a cost effective water treatment program for pork production.

**Table 1: Commercial Field Trial of AQUATIZE® in Nursery Pigs**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>AQUATIZE®</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Pigs Placed</td>
<td>52,000</td>
<td>52,000</td>
<td>----</td>
</tr>
<tr>
<td>Total Pigs at End</td>
<td>50,175</td>
<td>50,301</td>
<td>----</td>
</tr>
<tr>
<td>Number of Test Cycles</td>
<td>2</td>
<td>2</td>
<td>----</td>
</tr>
<tr>
<td>Number of Reps/Test</td>
<td>10</td>
<td>10</td>
<td>----</td>
</tr>
<tr>
<td>Total Weight at End (lbs)</td>
<td>1,254,370</td>
<td>1,306,280</td>
<td>----</td>
</tr>
<tr>
<td>Age of End (days)</td>
<td>+0.636</td>
<td>normal</td>
<td>0.531</td>
</tr>
<tr>
<td>Avg. Wt./pig at End (lbs)</td>
<td>49.99</td>
<td>52.04</td>
<td>(4.10%)</td>
</tr>
<tr>
<td>Feed Conversion Ratio</td>
<td>1.745</td>
<td>1.700</td>
<td>(2.58%)</td>
</tr>
<tr>
<td>Medication Costs/Pig ($)</td>
<td>$0.137</td>
<td>0</td>
<td>0.691</td>
</tr>
</tbody>
</table>

** The commercial company did not divulge all their proprietary information for the trial. Thus, we were never certain that they placed exactly 52,000 pigs in each of the two groups. Also, it was never clear that each test had exactly 10 barns in it, but it was clear that some barns held more pigs than other barns.

AQUATIZE® is used by commercial producers in Thailand and various other Asian countries, and the following note was received from the Marketing Manager in Thailand:
Dear Dr.: We did a test of AQUATIZE® at a pig nursery farm and got a beautiful result. We took a sample of the customer’s water supply and tested for bacterial contamination, and then we started using AQUATIZE® and retested after startup. AQUATIZE® reduced E. coli in the drinking water from 43 mpn/100 ml to less than 3 mpn/100 ml and reduced total Coliform bacteria from 460 mpn/100 ml to less than 3 mpn/100 ml. When we began using AQUATIZE® at the farm the pigs had much less diarrhea. AQUATIZE® is a very effective product.

Conclusion

Dirty, contaminated drinking water leads to costly diseases in animals that can adversely impact them their entire lives and this situation is more important today than a few years ago. Modern pork production farms are now more restricted in using antibiotics so utilizing effective water treatment programs to stop infectious agents is essential. By attacking pathogens at their source, AQUATIZE® reduces bacteria harmful to pig production and is an effective tool in providing clean nutrients to pigs resulting in a more efficient and profitable enterprise. As the test results reported here indicated that ADG, F/G, and mortality of pigs was improved considerably in the presence of pathogenic challenges --- all too frequently encountered in modern production facilities.