

Department of Animal Science

NEGLECTING POULTRY DRINKING WATER QUALITY CAN PROVE COSTLY

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Drinking water with adequate physical, chemical and microbiological quality in the poultry industry is of critical importance in today's "No Antibiotics Ever" (NAE) production environment. On many commercial poultry farms today, well over 100,000 broilers may have access to the same water supply source each time a flock is placed; therefore, any water quality issues with the farm's water supply will affect large numbers of birds. Drinking water can play a pivotal role in the transmission of some of the most common and dangerous bacterial, viral and protozoan poultry diseases. Water has always been the most vital — but also the most neglected — nutrient in terms of flock performance in the poultry industry. The cost of neglecting poultry water quality can be high. Water is a major component of blood, plays an important role in transporting nutrients to cells and is vital to removing waste products. A chicken's body is 70 percent water, and a loss of 10 percent of this water will result in the bird's death. Water also plays a primary role in digestion and respiration, both which are critical to thermoregulation. Broiler performance is determined by a variety of factors including feed, genetics, health status, air quality and house environment, and management practices, but in today's NAE landscape, drinking water quality may be the factor of greatest importance and the one most often overlooked.

Importance of water quality

NAE production programs highlight the importance of poultry drinking water and the high cost of neglecting the quality of this vital nutrient. We are being reminded that poultry drinking water quality is more important than we once thought. Previous use of antibiotics covered up management mistakes that allowed us to become lax in our monitoring of water quality. However, today's NAE programs are not forgiving of management mistakes, and, in many cases today, the bill has come due for past complacency with poultry drinking water quality issues.

In the past, we may have been able to medicate our way around a poor water quality issue. In the NAE world of today, there are consequences for ignoring these issues that can no longer be overcome with antibiotics. Water plays a role in every aspect of animal metabolism, and the absence of antibiotics in NAE programs has revealed several underlying issues. These issues likely have been present for some time but were being masked by previous antibiotic use and were either unknown or considered unimportant. Issues with water that can affect our flocks include:

- Poor flock performance (high feed conversion ratios, low weight gain)
- Enteric issues (excessive feed passage, gut sloughing, loose droppings)
- Low water intake (resulting in low feed intake)
- Disease issues flock after flock
- High mortality rates

A little antibiotic at the hatchery and in the feed was a powerful tool to provide flock protection for many years; however, mounting concern over antibiotic resistance and increasing consumer demands for chicken raised without antibiotics has changed today's poultry production landscape. As a result, the poultry industry has a big empty space in its toolbox created by the removal of antibiotics. Currently, there is a flood of new products appearing on the market, hoping to fill in that empty space and recapture some of what was lost when antibiotics were removed. The easiest delivery method for many of these products is in the drinking water system. Consequently, we are seeing a significant increase in water line and drinker system issues.

Water intake

Chickens normally consume approximately twice as much water as feed on a weight basis during normal environmental conditions, with consumption increasing linearly as ambient temperature increases above normal. Water consumption in poultry is dependent on several factors:

- Feed intake (reduced feed intake leads to reduced water intake and vice versa)
- Ambient temperature (water intake increases as temperature increases and vice versa)
- Contaminated water (mineral or bacterial issues can lead to decreased water intake)
- Warm water (water that comes from the well at too high a temperature or heats inside the drinker line during hot conditions may reduce intake)
- Type of drinkers (some systems supply more water faster than others)
- Drinker line height (lines that are too low or too high will reduce water intake)
- Water pressure (supply line and drinker line regulator pressure that is too high or low will affect water intake)

Drinkers should be checked regularly to ensure they are working properly. Leaking drinkers require immediate attention to prevent further issues and protect litter quality. Drinker system maintenance is a must, and systems must be cleaned and flushed regularly to remove any microbial or mineral build-up in the lines. A more thorough line cleaning and disinfecting with a higher sanitizer residual concentration may be necessary between flocks without birds present when stronger products can be used in the drinker system. Be sure to flush the lines with fresh clean water or water with an acceptable sanitizer residual concentration before birds are placed.

Taste, color and odor

There is likely no such thing as pure drinking water. There is always something in the water your chickens are drinking, and it's important to know what that is and at what level. If you don't know what's in your water, have it tested. A \$20 water sample is cheap insurance to know that your birds are drinking safe water. The water your chickens are drinking has a mineral profile that may or may not be harmful to them. It is important that drinking water be clear, tasteless, colorless and odorless. Contaminated water often exhibits different characteristics depending on the quantity and type of contaminants present.

- Water will appear cloudy or murky in the presence of particles such as silt, clay, mud or organic material. Water with these or other suspended particles can interfere with operation of the drinker system and may lead to adverse effects on flock performance.
- A rotten egg smell indicates the presence of hydrogen sulfide in the water. Hydrogen sulfide may combine with iron and form a black precipitate (iron sulfide) in the bottom of the water filter canister, which can also indicate the presence of sulfate-reducing bacteria.
- A reddish-brown color to water may indicate the presence iron.
- A blue color can be an indication of excess copper in water.
- Different salts can affect the taste of water. Ferrous and manganese sulfates leave a bitter taste to water.

Minerals occur naturally in most water sources and are necessary for life; however, some minerals in excess amounts can affect bird health and water line performance. Often overlooked, minerals can have a large effect on many areas of water quality. Poultry farms in Tennessee that have well water sources should pay attention to the mineral the mineral profile and dissolved solids concentration in poultry drinking water supplies due the presence of karst landscape in much of the state.

Iron alone may not cause bird health issues, but it can be a food source for bacteria, particularly *E. coli*. In addition, most iron-loving bacteria produce a type of slime that can build up in pressure-reducing regulator screens, filters, pressure tanks, in-house drinker line regulators, drinker lines and nipple drinkers. Sulfur can damage the bird's intestines, resulting in flushing, feed passage and a lack of nutrient absorption. Bacteria break down sulfur, creating hydrogen sulfide gas, which is extremely corrosive. This can happen in the well, in the water lines or in the bird. Iron and sulfur support bacteria that thrive as water temperature increases. The less disturbed the water environment, the more established the bacterial population becomes. Therefore, the first few weeks of the flock, when water is at its warmest and slowest flow rate, is a critical period for bacterial growth in the lines. Other minerals may also affect performance, including:

- Sodium + chloride (salt): flushing and diarrhea
- Magnesium: laxative effect, excess feed passage
- Zinc: astringent taste
- Nickel: heart and liver damage
- Lead: developmental issues, long-term performance issues in broiler breeders

Many times, growers fail to consider that zinc is often in the coating of the sheet iron on the chicken house. If the well is right beside the chicken house (Figures 1 and 2), is it possible that rainwater off the roof may move down the wellhead and carry zinc into the aquifer?



Figures 1 and 2. Can rainwater off the poultry house roof find its way down the wellhead and into the aquifer below?

Calcium and magnesium can form scale build-up in the water lines. If these minerals are present, it's important to descale the water lines once per year. Use an approved acid solution to get the pH of the water down to 5 or below, or scale won't dissolve. Let the solution remain in the lines for 24 hours, then flush all lines thoroughly with fresh water and trigger all the nipples. Realize that long-term use of acids without a water treatment program supports the growth of acid-loving algae, fungi, molds and yeasts. Acid use should be followed with a water treatment program. Depending on the condition of your water source, it may be necessary to consider a continuous daily water treatment program with hydrogen peroxide or chlorine. Make sure you monitor the sanitizer residual concentration at the end of the water lines. If you are using a chlorine-based sanitizer product, your target residual concentration should be 3 to 5 ppm, even though 1 ppm has been reported to be effective under a daily water sanitation program. For hydrogen peroxide-based products, 25 to 50 ppm is considered an effective residual concentration.

Bacteria and other creatures

Poultry houses are known to grow many other things besides chickens, particularly inside the watering system, such as:

- *Salmonella*
- *Campylobacter*
- *Pseudomonas*
- *Staphylococcus*
- *E. coli*
- *Listeria*
- Algae
- Yeasts
- Molds
- Viruses
- Parasites
- Enteric bacteria

Presence of bacteria in the water may be an indication of contamination with organic material. Water is often tested for total bacteria load and coliform bacteria load. Presence of coliform bacteria in drinking water indicates fecal contamination resulting from runoff to surface or

ground water supplies as coliform bacteria are generally found in the digestive tract of humans, livestock and birds. Algae and fungi can build up in the drinker lines, restrict the flow of water and clog the nipples. Bacteria can make the flock sick.

Water quality can change with the seasons, depending on the location and source of the water. In addition, the warm broiler house environment is ideal for rapid replication of microorganisms inside the water system. This can lead to biofilm formation in water lines and regulators. Biofilms are composed of many different types of bacteria and other organisms that live together in a sticky film inside the water lines. Biofilms live on very little nutrients and can cause disease issues flock after flock as bacteria are continuously released from the biofilm. Biofilms are very difficult to remove once established and provide a breeding ground where microorganisms can multiply. In addition, the biofilm protects the “bad bugs” from antibacterial agents that producers may use to clean the water lines. Regardless of the daily water sanitation program in place on the farm, a certain level of biofilm may still grow in the water system at the end of the flock grow-out period. Therefore, consider it necessary to clean water lines between flocks before the next flock is placed.

Water characteristics

The pH level is a measure of the acidity or alkalinity of water. A scale of 0 to 14 is used to measure pH, with 7 being neutral, neither acidic nor alkaline. Poultry drinking water that is too acidic can affect digestion and feed passage, corrode watering equipment and impair the use of water-soluble vaccines/medications. Poultry prefer water with a pH in the range of 6.2 to 6.8 but can tolerate a pH range of 5 to 8; however, water with a pH of less than 5 or greater than 8 may negatively impact chicken performance.

Hardness

Hardness refers to the amount of dissolved minerals, such as calcium and magnesium, in water. High levels of these dissolved minerals result in hard water and can cause buildup of scale in water lines. Hardness reduces the effectiveness of cleaners and disinfectants used in cleaning and disinfecting poultry barns and can interfere with administration of some medications. Hard water has not been proven to directly affect (either positively or negatively) poultry performance; however, it can adversely affect the watering system and equipment.

Nitrates and nitrites

Nitrogen contamination of poultry drinking water most often occurs in the form of nitrates and nitrites. Nitrate (NO_3) is produced during the process of decomposition of organic matter. Nitrite (NO_2) results during intermediate stages of decomposition of organic compounds. Water with the presence of nitrates and/or nitrites indicates that the water source has been contaminated by runoff containing fertilizers or animal wastes. Nitrates are soluble and can move with surface runoff or leach into the groundwater by percolation through the soil. Nitrate is nontoxic; however, after ingestion, microorganisms in the digestive tract convert nitrate to nitrite, which is toxic. Once nitrite reaches the bloodstream, it binds strongly with hemoglobin and reduces the oxygen-carrying capacity of the blood.

Iron

Birds may be tolerant of the metallic taste of water with high iron levels, but high iron may cause leaking water nipples and can promote the growth of *E. coli* and *pseudomonas*. Iron in the ferrous form, when exposed to air, is converted to ferric hydroxide, which gives water the typical rusty color.

Sodium and chloride (salt)

Excessive levels of sodium have a diuretic effect and increase water consumption leading to wet litter. Levels above 50 mg/L (50 ppm), together with high levels of sulfate or chloride, can adversely affect flock performance. Excessive levels of chloride have been shown to adversely affect metabolism and increase water intake resulting in wet litter. A balanced feed ration contains all the sodium and chloride need by the bird. Any additional sodium and chloride in the water supply can adversely affect performance and litter quality.

Water treatment options

With greater attention on removal of antibiotics from commercial poultry production, supplement use has increased as integrators and growers look to solve health and management issues in other ways. As a contract grower, do not run any additive/supplement on your flock without clearing it first with your service technician or live production personnel. For any supplement/additive to be successful, the water system must first be clean and the water supply safe. Understand any products that you plan to use: What are they? Why are they being used? What are the potential side effects to the birds and the water system? Are they really needed?

Water treatment options are available for water supplies that need help. The two most common water treatment options are chlorine and hydrogen peroxide. Understanding the various forms of chlorine available is important:

- Liquid chlorine: Often misused because of the pH with the water supply. If pH of the water supply is too low (< 6.0), chlorine will escape as a gas, decreasing effectiveness and increasing equipment corrosion. If pH is too high (> 8.5), the amount of hypochlorous acid formed will be greatly reduced, and the water will not receive adequate disinfection.
- Chlorine dioxide: More effective than liquid chlorine but requires mixing time and special handling.
- Gas chlorine: Most effective of all the chlorine options, but chlorine gas is dangerous and requires special knowledge and handling procedures.

If liquid chlorine is used, be aware that it can damage the rubber components of the drinker system, especially the rubber seals on nipple drinkers. Try to maintain a chlorine level of near 3 ppm at the end of the drinker line farthest from the control room. In addition, bacteria can build a resistance to chlorine over time. If you notice that chlorine is no longer doing as good a job as it did previously, switch to an alternative product (i.e., hydrogen peroxide) for a couple of flocks to address the issue.

Hydrogen peroxide products are available in varying percentage strengths, ranging from 20 to 50 percent. Visit with your service technician to find out what your integrator recommends. Some products have additives that significantly enhance the stability of hydrogen peroxide. In most

cases, generic, technical-grade and most food-grade hydrogen peroxides do not contain these added ingredients and may not be as effective. The enhanced stability hydrogen peroxides may only be available through poultry supply warehouses or their catalogs.

Summary

NAE production programs have taught us that we must be proactive with water treatment programs. A high price will be paid if flocks are provided with anything less than a clean, safe, high-quality drinking water supply. Consider the fact that any program capable of providing a clean, safe water supply is actually two programs:

1. A specific program for thoroughly cleaning water lines when the houses are empty.
2. A specific program for daily treatment of water when birds are on the farm.

A water sample analysis is a must for growing birds in any NAE program. Growers must know what is in the water their chickens are drinking if they expect to help their birds perform at their best. Ask yourself this question: “Will I drink the water that my chickens are drinking?” If your answer is no, then you’ve got some work to do.



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