Department of Animal Science

# ATTENTION NEEDED ON POULTRY DRINKING WATER

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Even though water is the most critical nutrient for our birds, for the most part it remains the most neglected. That must change. For far too long, if the drinker lines had water when the chickens wanted a drink and the cool cell pads got wet when the evaporative cooling system kicked on, neither producers nor service technicians nor the poultry industry in general gave much attention to water. However, it's a different poultry world today than it was five, ten or twenty-five years ago. Change is never easy, but we must change the way we think and place greater importance on the quality of water our birds are drinking today. Failure to do so is costing producers and the poultry industry money in the "No Antibiotics Ever" (NAE) environment we find ourselves in today. In the past, a little antibiotic at the hatchery and in the feed allowed producers and the industry to get a little soft on water management in general and, specifically, on water treatment programs, but those days are gone now because, for the most part, antibiotics are gone. The industry and its growers must realize that drinking water quality for poultry has never been more important than it is today. We've become spoiled where water is concerned and must focus more attention on poultry drinking water quality in the future.

## Focus on basics

High levels of minerals, bacteria and other pollutants in poultry drinking water can cause detrimental effects on normal poultry physiological functions resulting in poor performance (Hess and Macklin, 2019). Quality drinking water for poultry can be difficult to comprehend because standards have often been derived from recommendations for other animal species or perhaps from human standards. Guidelines may have initially been established based on sickness or mortality and not on a deficiency in performance. In addition, the water quality of an aquifer can change over time. Therefore, it is important to submit a water sample on an annual basis for analysis as part of a water management program. The results of these annual analyses should be used to guide the water treatment program over the next year. If you are uncomfortable

interpreting your water analysis, seek assistance for someone that can help you; a water expert from the Extension service or from various water treatment companies can assist you in understanding your analysis.

Look for patterns that may indicate possible water quality problems. If you see issues like high mortality rates, poor flock performance on a regular basis, enteric issues (loose droppings, gut sloughing, excess feed passage, etc.), flock after flock that breaks with disease, or low flock water consumption compared to neighboring growers, the cause is most likely related to water quality. Water quality does not play favorites, and growers with good or excellent management practices are as much at risk as those who may be less concerned about management practices. Perhaps even more so because good managers may be willing to try multiple alternatives to fix the problem as quickly as possible. However, it's important to never try more than one thing at a time on any one flock. If you try three things at once and the flock performs better, you won't know which product made the difference. Also, products can work against each other. Perhaps one product would have worked, but when you tried three things at once, they all worked against each other and nothing changed, or perhaps things may have gotten worse because the products weren't compatible.

Poultry houses may have been designed to grow chickens and turkeys, but they are notorious for growing other things as well. The water system (regulators, drinker lines, nipples, etc.) in these houses can grow bacteria, biofilm, mold, algae, yeasts, parasites and viruses — particularly when chicks are small, water movement is slow and water in the lines is warm because the house is warm for the chicks. Bacteria, mold, fungi, minerals and water additives can interact in the water source and within the piping and drinkers to complicate management practices necessary to guarantee the best quality water for optimum performance (Oveido, 2006). While one thousand bacteria per milliliter may be the acceptable standard for poultry drinking water, up to one million bacteria per milliliter have been found in contaminated water supplies (Watkins, 2002). The warm moist poultry water system environment is ideal for bacterial growth in the water lines. That's why it's critical to 1) know what's in your water, 2) change filters regularly and flush water lines frequently, and 3) educate yourself about any products you may be considering using to counteract what's in your water. Do these products have side effects? Will these products cut loose slime, biofilm or hard water scale/deposits that can clog nipple drinkers?

Under ideal conditions, bacteria should not be present in poultry drinking water. Their presence often indicates contamination by organic materials. For example, presence of coliform bacteria in drinking water is often related to fecal contamination resulting from runoff to surface or ground water supplies (Brake and Hess, 2001). Table 1 lists established guidelines for poultry drinking water quality. Be aware that factors such as bird age, lighting programs and environmental temperature can affect water consumption. As birds age they consume more water, but overall consumption relative to body weight decreases. When environmental temperatures are high, water intake increases, with perhaps as much as two to three times or more greater intake under heat stress conditions. In houses with a lighting program in place, growers see peak water consumption occurring just after the lights come on and again just prior to the lights going out.

## NAE has changed things

NAE production programs have removed most antibiotics from the hatchery and the feed and changed the way chickens are grown today. This removal of antibiotics has revealed several

things we could not see before. Many of these issues were likely present for some time but were being masked by a small amount of antibiotic use or else were thought to be unimportant (Tabler et al., 2019). However, without antibiotics, those issues have made themselves known and must

*Table 1. Poultry water quality standards and treatment options.*[1]

| Water quality indicator | Levels considered average | Maximum acceptable level | Maximum acceptable levels indicate | Treatment options/comments |
|---|---|---|---|---|
| Total bacteria (TPC)<br>Total coliforms<br><br>Fecal coliforms | 0 CFU/ml<br><br>0 CFU/ml<br><br>0 CFU/ml | 1,000 CFU/ml<br>50 CFU/ml<br><br>0 CFU/m | Dirty system, may taste bad and could have pathogens in the water system. Water with >50 total coliforms or any fecal coliform has been in contact with feces | Clean the system between flocks with approved sanitizing cleaners and establish a daily water sanitation system when birds are present; shock chlorinate as well |
| pH | 6.5-7.8 | 5-8 | Below 5 — metal corrosion<br>Above 8 — water sanitizers work poorly; "bitter" taste | Raise pH with soda ash, lime or sodium hydroxide. Lower pH — phosphoric acid, sulfuric acid and hydrochloric acid (strong alkalinity); citric acid or vinegar (weak alkalinity) |
| Alkalinity | 100 mg/l | 300 mg/l | Associated with bicarbonate, sulfates and calcium carbonate; can give water a bitter taste that is undesirable to the birds; difficult to lower pH at high levels. Corrosive to cool cell pads | Acidification. Anion exchange dealkalizer can be reduced by removing free carbon dioxide through aeration. |
| Total hardness | Soft 0-75mg/l CaCO2<br>Somewhat hard 76-150<br>Hard 151-300<br>Very hard >300 | | Hardness causes scale, which reduces pipe volume and makes drinkers hard to trigger or leak (main factors are calcium and magnesium, but iron and manganese contribute a small amount) | If water is high in sodium, do not use water softener unless potassium chloride is used instead of sodium chloride. Polyphosphates will tie up hardness and keep in solution.<br>Water acidification to pH below 6.5 |
| Calcium (Ca) | 60 mg/l | | No upper limit; if values are above 110 mg/l, may cause scaling | Treatment same as for hardness |
| Magnesium (Mg) | 14 mg/l | 125 mg/l | May cause flushing because of laxative effect if high sulfate is present | Treatment same as for hardness |
| Iron (Fe) | 0.2 mg/l | 0.3 mg/l | Birds tolerant of metallic taste<br>Drinkers may leak from Fe deposit<br>Can promote bacteria growth (E. coli and Pseudomonas) | Treatment: addition of one of the following; chlorine, chlorine dioxide, or ozone then filtration removal with proper sized mechanical filtration |
| Manganese (Mn) | 0.01 mg/l | 0.05 mg/l | Can result in black grainy residue on filters and in drinkers | Similar to iron; can be more difficult to remove due to slow reaction time<br>Chlorination followed by filtration most effective in 8.5 pH range, needs extended contact time with chlorine prior to filtration unless using Iron X media |
| Chloride (Cl) | 50 mg/l | 150 mg/l | Combined with high Na levels, can cause flushing and enteric issues<br>Can promote Enteroccoci bacterial growth | Reverse osmosis, mix with non-saline water, keep water clean and use daily sanitizers such as hydrogen peroxide or iodine to prevent microbial growth |
| Sodium (Na) | 50 mg/l | 150 mg/l | Can cause flushing in combination with high Cl levels. Can promote Enteroccoci bacterial growth | Treatment same as chlorine |
| Sulfates | 15-40 mg/l | 200 mg/l | Can cause flushing<br>Hydrogen sulfide (rotten egg smell) indicates sulfur-loving bacterial growth; can cause flushing and air locks in water system; sulfides can gas off, so test results may underestimate actual levels present | Aerate water into holding tank to gas off sulfur. Anion exchange (chloride based) Treat with oxidizing sanitizers. Then filtration. If rotten smell is present, shock chlorination of well is recommended plus daily water sanitation while birds are present |
| Nitrates | 1.5 mg/l | 25 mg/l | Poor growth and feed conversion may indicate fecal contamination; test for coliform bacteria | Reverse osmosis<br>Anion exchange |
| Lead (Pb) | 0 mg/l | 0.05 mg/l | Can cause weak bones and fertility problems in broiler and turkey breeders | Not naturally occurring. Check for pipes, fittings or solder that contain lead. Can be reduced by water softeners and activated carbon |
| Copper (Cu) | 0.002 mg/l | 0.6 mg/l | High levels may cause oral lesions or gizzard erosion | Most likely results from corrosion of pipes or fittings |

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|---|---|---|---|---|
| Zinc (Zn) | | 1.5 mg/l | Growth may be reduced at high levels | Water softener and activated carbon will reduce adsorption |

[1]Adapted from Watkins (2008).

*Figure 1. Baby chicks often receive product through the drinker system.*

*Figure 2. Older birds may also receive supplements/additives through the water system.*

be addressed. Were antibiotics our solution to poor drinking water quality in the past? Did we medicate our way out of poor water quality and less-than-ideal management practices with a little help from antibiotics? On many poultry farms today, the answer to those questions is yes. Therefore, we now have a variety of new products on the market hoping to fill the void left when antibiotics were removed and offering integrators, growers additives and supplements that may enhance flock performance and recapture some of the production benefits that antibiotics offered. The water system is often the easiest way to deliver many of these products to baby chicks (Figure 1) and older birds (Figure 2), and, as a result, we are seeing a huge increase in water line issues, from leaking and clogged nipples to increased bacterial and biofilm challenges to decreased water intake and reduced flock performance.

NAE production is a different way of growing chickens, and we are still learning how best to do it. It is a big change and change is hard. It's as big a change as going from bell-type or eight-foot trough drinkers to nipple drinkers or from curtain-sided, natural ventilation to solid-walled, tunnel ventilation. With the host of supplements and additives available today, including probiotics, prebiotics, organic acids, essential oils, vitamins, minerals, electrolytes, etc., it is difficult to know where to begin. Some of these products have shown promise — at least some of the time — in poultry health programs, but there is a downside to running them through the water system. For example, essential oils are being used by many integrators today as a natural alternative to antibiotics. There are hundreds of essential oils and essential oil combinations currently being tested by the poultry industry. However, essential oils are some of the slimiest and stickiest products used by the industry, and, if delivered through the water system, they are some of the most difficult supplements to clean up. If you run essential oils through the water system, you must have a thorough water line cleaning program between flocks.

Probiotics are live bacterial microorganisms intended to provide health benefits. While these are good bacteria, all bacteria can clog the drinker system. Prebiotics are carbohydrate- or plant-based nutrients used to enhance growth of bacteria in the gut. However, they will also enhance growth of bacteria in the water lines when given through the water system. Vitamins, minerals and electrolytes are often given to encourage and improve bird health; however, they also

encourage bacteria health in the water lines as well and further enhance line and nipple clogging. High levels of Total Dissolved Solids (TDS) are also harmful to poultry production (Brake and Hess, 2001).

*Table 2. Guidelines for poultry for the suitability of water with different concentrations of Total Dissolved Solids (TDS).*[1]

| TDS (ppm) | Comments |
|---|---|
| Less than 1,000 | These waters should present no serious burden to any class of poultry. |
| 1,000-2,999 | These waters should be satisfactory for all classes of poultry. They may cause watery droppings (especially at the higher levels) but should not affect health or performance. |
| 3,000-4,999 | These are poor waters for poultry, often causing watery droppings, increased mortality and decreased growth (especially in turkeys). |
| 5,000-6,999 | These are not acceptable waters for poultry and almost always cause some type of problem, especially at the upper limits, where decreased growth and production or increased mortality probably will occur. |
| 7,000-10,000 | These waters are unfit for poultry but may be suitable for other livestock. |
| More than 10,000 | These waters should not be used for any livestock or poultry. |

[1]National Research Council, 1974.

Calcium, magnesium and sodium salts are the primary components that contribute to TDS. Table 2 gives guidelines suggested by the National Research Council (1974) for the suitability for poultry of water with varying levels of TDS. There is likely no such thing as pure drinking water today. There is always something in the water such as minerals, bacteria or some other contaminant. A water analysis is the only way to know what is in the water your flock is drinking. Once you know what's in the water, it will be easier to build an effective treatment program.

## Treatment options

Chlorine and hydrogen peroxide are the two most common water treatment options. Chlorine comes in various forms, and it's important to understand each of them:

- Liquid chlorine is often misused because of the pH of the water source. If pH of the water is low (<6.0), chlorine escapes as a gas, decreasing its effectiveness and increasing equipment corrosion. If pH is high (>8.5), the amount of hypochlorous acid formed is greatly reduced, and the water will not be satisfactorily disinfected.
- Gas chlorine is the most effective of all the chlorine forms, but chlorine gas is dangerous and requires special knowledge and handling practices.
- Chlorine dioxide is more effective than liquid chlorine and less dangerous than chlorine gas but requires mixing time and special handling

Even though chlorine is a popular treatment option, liquid chlorine can damage rubber components of the drinker system, especially the rubber seals on nipple drinkers if mixed too strongly. Strive to maintain a level of around 3 ppm at the end of the drinker line farthest from the control room. Be aware that chlorine breaks down quickly and does not compete well with other additives. In addition, bacteria tend to build a resistance to liquid chlorine over time. If liquid chlorine seems to no longer be working, switch to an alternative (i.e., hydrogen peroxide) for a few flocks. Before starting any treatment program, visit with your integrator to determine

what products are allowed and always follow label instructions. Always filter the incoming water supply. Depending on the source, you may need a cotton, charcoal or greensand filter. Reverse osmosis, while expensive, is another option in extreme cases, although it uses large amounts of water.

Hydrogen peroxide products are available on the market in several different strengths, ranging from 20 percent to 50 percent. Different integrators may likely use different strengths. Check with your service technician, flock supervisor or live production manager to determine what is recommended. Some products have additives that enhance the stability of hydrogen peroxide. In most cases, generic, technical-grade or food-grade hydrogen peroxides do not contain these added ingredients and may not be as effective. The enhanced grades of hydrogen peroxide may only be available at select locations such as poultry supply houses or through distributors.

## Summary

More attention must be focused on poultry drinking water quality in the future. NAE programs are not forgiving and will not tolerate management mistakes or poor water quality. Every grower should know what is in the water their chickens are drinking. This requires, at minimum, a water mineral analysis and perhaps a bacterial analysis as well. You can't fix a problem until you know what the problem is. Therefore, a water analysis is a must. Some universities will do a water mineral analysis for around $20. That's cheap insurance to know whether you have a poultry water quality issue. NAE production requires that we be proactive, rather than reactive, with any water treatment program. Simple is best, so if you don't need to run something through your water system, don't. The water system will stay cleaner that way and safe, clean water is what's best for your birds. If you are having flock health and performance issues and have ruled out other causes, consider the possibility that drinking water quality could be the problem. Water quality problems won't get better with time so take whatever steps necessary to address the issue.

## References

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