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Biosecurity and Hygiene Featured Articles

Poultry Drinking Water Primer

By Brian D. Fairchild and Casey W. Ritz, Extension Poultry Scientists, The University of Georgia - Water is a critical nutrient that receives little attention until a problem arises. Not only should producers make an effort to provide water in adequate quantity, they should also know what is in the water to be used in evaporative cooling systems and consumed by the birds.

Functions of Water

Poultry producers need water for birds to drink, to reduce air temperature (includes evaporative cooling pad and fogging systems), and to clean and sanitize the facility. Broilers consume approximately 1.6 to 2.0 times as much water on a weight basis as feed. Water is a critical nutrient in bird metabolism and nutrition. From a physiology perspective, water consumed by the bird is used for nutrient transportation, enzymatic and chemical reactions in the body, body temperature regulation, and lubrication of joints and organs.

There is a strong relationship between feed and water consumption, so water can be used to monitor flock performance. Many of the electronic controllers in poultry houses have the ability to monitor daily water consumption. A potential problem may exist if there is a sudden change in water intake. Bird uniformity between the front and back of the house can be monitored using water consumption. Water consumption will be greater in the area of the house that has more birds. When birds are not distributed evenly between the front and back of the house, increased competition for feed and water space and can reduce bird performance.

Factors Affecting Water Consumption

Several factors affect water consumption:

Bird Age: Water consumption increases with age but decreases as a percentage of body weight.

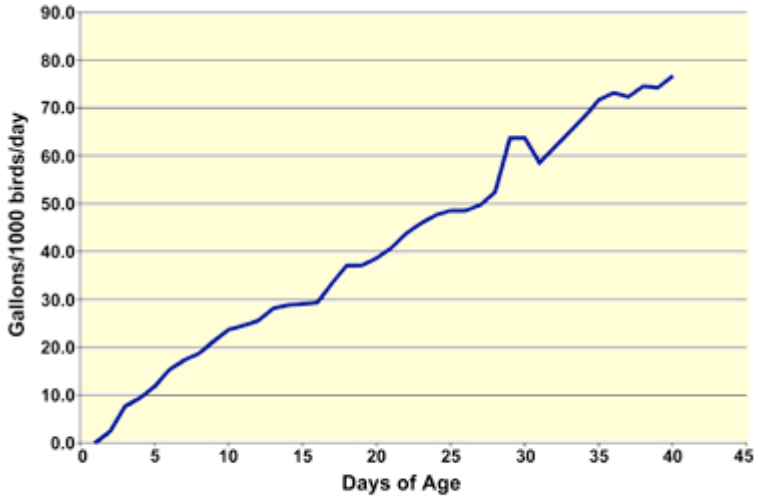

Figure 2. Water consumption in a tunnel ventilated broiler house.

Environmental Temperature/Heat Stress: Birds consume more water as temperature increases. One of the main ways birds regulate body temperature is to remove heat from the body by evaporating water through the respiratory system during panting. As birds pant, water is lost and needs to be replaced in order to maintain body water balance. Water consumption can double and even triple during periods of heat stress. Water consumption in broilers increases approximately 7 percent for each degree Fahrenheit increase in temperature. A study at the University of Georgia examined the relationship of feed consumption to water consumption of seven consecutive flocks on a commercial broiler farm. As temperatures increased, the water consumed per pound of feed consumed also increased (Table 1).

Table 1. Water consumption response to different weather conditions.

	lb of water per lb of feed
Cold weather	1.55
Mild weather	1.65
Hot weather	1.75

Water Temperature: Several studies have examined the effects of providing cool water to birds during hot weather. In most of these studies, water temperature has improved the performance of broilers and layers. Any water temperature below the body temperature of the bird will be beneficial. The water consumed will help dissipate body heat temperature. In commercial operations, however, air speed is the most effective way to keep birds cool. Water is difficult to cool significantly and economically when it is moving hundreds of feet down a house.

Electrolytes: During periods of potential heat stress, many producers supplement drinking water with electrolytes. Electrolytes are certain minerals that can be found in the blood and are important for normal cell function and growth. Electrolytes, as the name implies, help regulate nerve and muscle function by conducting electrical signals from nerves to muscles. Electrolytes are also important for the acid-base balance of the blood and fluid retention. Some of the

electrolytes found in blood plasma include sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), chlorine (Cl), bicarbonate (HCO3) and sulfate (SO4). The addition of the electrolytes not only replenishes those depleted during heat stress, it also stimulates water consumption. When the results of these are added together (electrolytes and increased water consumption), the mortality due to heat stress can be reduced.

Lighting Programs: Light is another environmental factor that can influence bird water consumption. In operations that use lighting programs, two distinct water consumption peaks can be observed. The first peak is just after the lights come on (dawn), and the second is just prior to lights turning off (dusk). In Figure 3, the water consumption actually starts to drop about an hour prior to the lights turning off. This indicates that the birds are anticipating the upcoming dark period and activity in the house has already begun to decline.

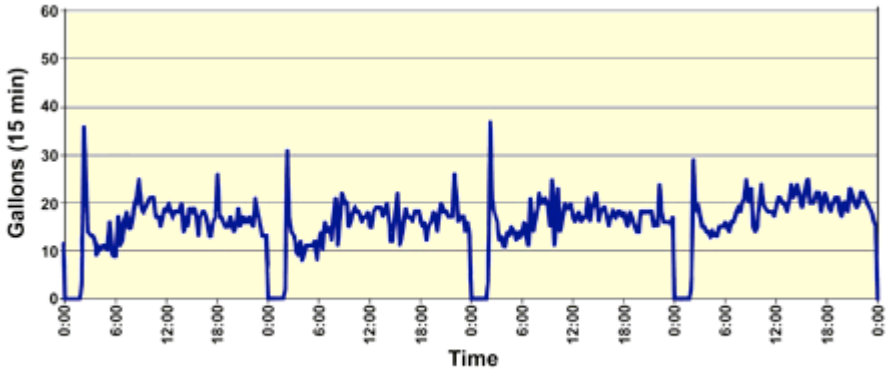

Figure 3. Lighting influences water consumption.

The correlation of water consumption with feed intake and many environmental factors indicate its importance in bird metabolism and body function. Efforts should be made in all poultry operations to ensure that adequate and unlimited access to water is provided. Failure in doing so will result in poor egg production, reduced growth, and reduced feed efficiency.

Water Quality

While water is composed of hydrogen and oxygen molecules (H2O), it is a universal solvent and can contain many minerals and compounds. The only sure way to get pure water is to use distillation or other treatment methods to remove dissolved minerals and compounds. While we do not need pure water for poultry drinking water, we do not want heavily contaminated water either. Water composition varies with geographical region as the nature of the geological makeup changes. Water contamination can occur if surface water drains into the well. All farms should submit water samples to a qualified laboratory for testing to establish a baseline for water quality. This will help producers determine if and what water treatment might be warranted.

All poultry operations should be concerned about water quality. Poor water quality may interfere with digestion and subsequent bird performance. The effectiveness of vaccines and medications administered through the water lines could be reduced when water quality is poor. Water contaminants could create equipment problems that would either restrict the amount of water available for consumption or affect the evaporative cooling and fogging systems. Reduced water consumption or cooling capacity would have detrimental effects on both growth and reproduction.

Poor water quality could also cause leaky water nipples inside the house, which will wet litter and lead to increased ammonia production. Poor litter quality and high levels of ammonia can cause reduced performance and livability.

Standards for water quality should include factors that affect taste, solid buildup within water systems, and toxicity. Factors that should be observed for poultry production include, but are not limited to:

- **Color:** Water is colorless, and any color in the water may indicate an increased contamination level.

- **Turbidity:** Particles such as clay, silt, sand or organic matter in suspension can cause the water to appear cloudy or muddy. Turbid water can cause leaky nipples and clog fogging nozzles.

- **Hardness:** Calcium and magnesium salts cause the water to be "hard" and can lead to scale and sludge buildup within water lines. Hardness reduces the effectiveness of soaps and disinfectants and interferes with the administration of some medications.

- **Iron (Fe):** Iron will stain almost everything it contacts, and it is a common water quality issue. Recent studies indicate that iron in the water does not appear to affect poultry health, but some of the iron may form solid particulates such as iron oxide, which can lead to equipment problems. These small particles can cause leaky nipples and block fogging nozzle openings. Either of these conditions can have negative impacts on poultry production. Iron bacteria are more likely to thrive in water with high iron concentrations. As a result, biofilm buildup can occur, which can obstruct nipple drinkers and promote pathogen proliferation.

- **Manganese (Mg):** While manganese itself does not cause a negative effect on poultry health, like iron, it can form solid particulates that can cause leaky nipples and clog foggers.

- **Nitrate-N (N):** Elevated nitrate concentrations indicate decaying organic material. It has been correlated with poor oxygen use in animals, but recent studies observed no differences in broiler performance with nitrate levels as high as 600 ppm. Presence of nitrate is a good indicator that water should be checked for bacteria.

- **pH:** The pH is a measure of acidity or alkalinity. A scale from 0-14 is used to measure pH. A value of 7.0 is neutral, values below 7.0 are acidic and values greater than 7.0 are basic. A pH of 6.0 to 6.8 is preferred for broiler production, but birds can tolerate a pH range of 4 to 8. A pH range of greater than 8 could cause reduced water consumption.

- **Alkalinity:** Caused by calcium carbonate, bicarbonate or sulfate. High alkalinity increases the buffering capacity of water.

- **Total solids:** Total solids represent the total amount of solid material in both suspension and solution. Total solids are not directly linked to any poultry health issues, but equipment function and water delivery could be nega-tively affected by total solids, which could influence bird performance.

- **Toxic compounds:** The amount will vary depending on the compound, but elements such as lead, selenium and arsenic should be kept below 1.0 ppm to prevent bird health problems as well as residues.

- **Dissolved oxygen:** Normal ground water concentrations have little or no dissolved oxygen. Concentrations greater than zero indicate possible surface water influence.

- **Bacteria:** Keep bacteria levels to a minimum (Table 2).

Table 2. Use the following table as a guide for drinking water quality for poultry.

Contaminant, Characteristic or Mineral	Maximum Acceptable Levels
Bacteria	
Total Heterotrophic Bacteria	100 CFU/100 ml
Coliform Bacteria	50 CFU/100 ml
pH	6.0 – 8.0
Hardness	110 ppm
Naturally Occurring Compounds	
Calcium	500 ppm
Chloride	250 ppm
Copper	0.6 ppm
Iron*	0.03 ppm
Magnesium	125 ppm
Manganese**	0.05 ppm
Nitrate***	25 ppm
Phosphorus	0.1 ppm
Potassium	500 ppm
Sodium	50 ppm
Sulfate	250 ppm

*Iron as high as 660 ppm has been shown to not affect bird health, but it will have detrimental effects on water lines and fogging systems (Fairchild et al., 2005).
**Manganese as high as 20 ppm has been reported to not affect bird health, but it can have negative effects on water lines and fogging systems (Batal et al., 2005).
***Nitrates as high as 600 ppm have been shown to not affect bird health (unpublished data).

Many of the water quality standards for poultry drinking water were originally developed from those for human drinking water. Few of the standards recommended today are based on research utilizing broiler or layers. Recently, a series of studies has been conducted examining the effects of iron (Fe), manganese (Mn), nitrates (NO_3) and pH levels in drinking water on poultry performance. The results of these studies have found that very high levels of Fe, Mn and NO_3 do not impact broiler health. In those studies no differences in performance were noted due to 600 ppm of Fe, 600 ppm of NO_3 and 20 ppm of Mn. It should be noted that the water lines were thoroughly flushed between studies and that particulates that result from high Fe and Mn levels can lead to equipment problems such as leaky nipples and clogged fogging nozzles. These studies tested each contaminant individually, and combinations of various

contaminants at increased concentrations may still impact broiler performance. When birds are experiencing problems such as feed passage or poor feed conversion, however, broiler performance is more likely to be affected by improper equipment function rather than bird health due to high concentrations of these substances. Poor water quality can lead to increased microbial growth (such as iron bacteria) and biofilm buildup.

Water Management Tips

- **Conduct water tests.** Each farm should have its well water tested. Water quality can change during periods of heavy rain or drought, and additional water tests during these periods will ensure that water lines continue to deliver adequate water volume for both the birds and the cooling systems. County extension agents can provide more information on the tests available, provide information on fees for testing, and submit samples to the Agricultural and Environmental Services Laboratory at the University of Georgia.

- **Change filters regularly.** Sediment and other particulates can cause leaky water nipples that can have negative effects on litter quality. Clogged filters restrict water flow to the drinker and cooling systems. In some cases, simple cartridge filters may not be adequate, such as for water with high iron. In those cases, consider other water treatments.

- **Flush water lines regularly.** Perform a high pressure flush on water lines between each flock and after adding supplements through the medicator (i.e., vaccine, medications, vitamins, electrolytes, etc.).

- **Plan ahead before treating water.** Before implementing water treatment or sanitation programs, consult your county agent to be sure contaminants in your water will not react negatively and cause the water system to become clogged.