extension
ALABAMA A&M & AUBURN UNIVERSITIES

Evaluating Water Quality for Poultry

► Water is the most important nutrient for poultry; survival time is limited in its absence. Birds can survive for longer periods without any other nutrient than they can survive without water.

Although water is regarded as the most essential nutrient, it is impossible to state its exact requirements. Birds generally drink approximately twice as much water as the amount of feed consumed on a weight basis. During periods of extreme heat stress, water requirements may easily quadruple.

Although the importance of providing a sufficient amount of water or adequate access to it is well accepted; however, the importance of good water quality is becoming apparent with antibiotic-free production. Water quality attributes can have a direct or indirect effect on performance. High levels of bacterial contaminants, minerals, or other pollutants in drinking water can have detrimental effects on normal physiological properties resulting in inferior performance.

Water quality can be evaluated by a number of criteria. It can be difficult, however, to describe good quality drinking water for poultry because many of the standards have been derived from recommendations for other species of animals or from human standards. In many cases, guidelines have been established based on mortality and not deficiencies in performance. Submitting a water sample annually for analysis should be an important part of good water management. The results of the analysis should be interpreted appropriately to determine the proper course of action. The following are some of the most important factors that influence water quality.

Color, Taste, Odor

Drinking water should be clear, tasteless, odorless, and colorless. As a general observation, a reddish-brown color may indicate the presence of iron, while a blue color indicates the presence of copper. Hydrogen sulfide is indicated by a rotten egg odor. Hydrogen sulfide may also combine with iron to form black water (iron sulfide) that may also implicate the presence of sulfate-reducing bacteria. Taste can be affected by the presence of salts, and a bitter taste is usually associated with the presence of ferrous and manganese sulfates.

Bacteria

The presence of microorganisms is typically a result of surface contamination by organic materials and can result in poor performance. The presence of coliform bacteria is generally related to fecal contamination of drinking water due to runoff to surface or groundwaters. Ideally, bacterial contaminants should not be present in drinking water, and measurable levels should be zero. Chemical treatments or filtration of the water supply can eliminate bacterial contaminants. Samples taken for bacterial testing should be obtained in a sterile manner and may need to be taken at the source and at strategic points to localize any problems.

pH

The acidity or alkalinity of water is measured by pH. A pH of 7 indicates that the water is neutral, a pH less than 7 indicates acidity, and a pH greater than 7 indicates alkalinity. Low pH water can be unpalatable and corrosive to equipment. It may have a negative impact on performance. High pH water is also unacceptable since it reflects high levels of calcium and magnesium, which can clog watering systems. Poultry accept water on the acid side better than they accept water on the alkaline side. Typically, wells in Alabama range in pH from 5 to 6.5. Municipal water systems may range in pH from 6 to 9 depending on their water sources.

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Turbidity

Turbidity results from the suspension of materials such as silt, clay, algae, or organic materials in water. Levels of turbidity above 5 ppm result in unpalatable water and indicate surface contamination. Turbid water can be filtered to remove particular contaminants and prevent clogged water lines.

Total Dissolved Solids

Measurement of total dissolved solids (TDS), or salinity, indicates levels of inorganic ions dissolved in water. Calcium, magnesium, and sodium salts are the primary components that contribute to TDS. High levels of TDS are the most commonly found contaminants responsible for causing harmful effects in poultry production. Table 1 provides guidelines suggested by the National Research Council (1974) for the suitability for poultry water with different concentrations of total dissolved solids (TDS), which are the total concentration of all dissolved elements in the water.

Hardness

Hardness refers to the presence of dissolved minerals such as calcium and magnesium in either bicarbonate or sulfate form and is expressed as an equivalent of calcium carbonate. It measures the tendency of water to precipitate soap and form scale. Hard water is commonly associated with the buildup of deposits and the formation of scale in the components of the watering system. Hardness is not commonly harmful to poultry unless certain ions are present in toxic amounts. High levels of magnesium sulfate (MgSO4) may cause an increase in water consumption, wet droppings, and a drop in production. Extreme hardness may diminish the effectiveness of water-administered medications, disinfectants, and cleaning agents.

Mineral Contaminants

A wide variety of minerals are commonly found in drinking water. Normally, they are found in relatively low concentrations and cause no harm (table 2).

Nitrogen contamination of water supplies usually occurs in the form of nitrates and nitrites. Both are a result of biological decay of animal or plant matter, chemical fertilizers, or animal wastes. The presence of nitrates often suggests bacterial contamination, since their presence is often a direct result of the seepage of surface water from surrounding fields that were fertilized by either chemicals or animal manures.

Nitrate itself is not toxic. After ingestion, however, it is converted to the toxic form of nitrite by microorganisms found in the intestinal tract of the animal. Once absorbed into the bloodstream, nitrite binds strongly to hemoglobin and, thereby, reduces the oxygen carrying capacity of the blood. Chronic nitrate toxicity causes poor growth, anorexia, and poor coordination. Studies demonstrate that nitrate nitrogen levels in the drinking water as low as 3 to 5 mg/lt depress broiler growth rate.

High concentrations of sulfates can combine with magnesium to form Epsom salt or with sodium salts that cause a laxative effect and can result in wet litter. High concentrations of sodium or chloride may also increase water consumption and increase litter moisture. High levels of sulfate may also interfere with the intestinal absorption of other minerals such as copper.

The formation of scale in the watering system can be attributed to high levels of or combinations of sulfate, magnesium, or calcium.

Table 1. Suitability of Water with Different Concentrations of Total Dissolved Solids (TDS)

TDS (ppm)	Comments
Less than 1,000	These waters should present no serious burden to any class of poultry.
1,000 to 2,999	These waters should be satisfactory for all classes of poultry. They may cause watery droppings (especially at higher levels) but should not affect health or performance .
3,000 to 4,999	These are poor waters for poultry, often causing watery droppings, increased mortality, and decreased growth.
5,000 to 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 to 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.

Source: National Research Council, 1974. Nutrients and Toxic Substances in Water for Livestock and Poultry, National Academy of Sciences, Washington, DC.

Table 2. Drinking Water Quality Guidelines for Poultry

Contaminant or Characteristic	Level Considered Average	Maximum Acceptable Level	Remarks
Bacteria			
Total bacteria	0/ml	1,000/ml	0/ml is desirable.
Coliform bacteria	0/ml	50/ml	0/ml is desirable.
Nitrogen compounds			Levels from 3 to 20 mg/l may affect performance.
Nitrate	10 mg/l	25 mg/l	
Nitrite	0.4 mg/l	4 mg/l	
pH	6.3 to 7.5	----------	A pH of less than 6.0 is not desirable. Levels below 6.3 may degrade performance.
Total hardness	60 to 180	----------	Hardness levels less than 60 are unusually soft; those above 180 are very hard.
Naturally occurring chemicals			Levels as low as 14 mg/l may be detrimental if the sodium level is higher than 50 mg/l.
Aluminum		5 mg/l	
Arsenic		0.5mg/l	
Boron		5 mg/l	
Cadmium		0.02 mg/l	
Chloride	14 mg/l	250 mg/l	Levels as low as 14 mg/l may be detrimental if the sodium level is higher than 50 mg/l
Cobalt		1 mg/l	
Copper	0.002 mg/l	0.6 mg/l	Higher levels produce a bad odor and taste.
Fluoride		2 mg/l	
Iron	0.2 mg/l	0.3 mg/l	Higher levels produce a bad odor and taste.
Lead		0.02 mg/l	Higher levels are toxic.
Magnesium	14 mg/l	125 mg/l	Higher levels have a laxative effect. Levels greater than 50 mg/l may affect performance if the sulfate level is high.
Manganese		0.05 mg/l	Higher levels may be laxative.
Mercury		0.003 mb/l	Higher levels are toxic.
Potassium		20 mg/l	Higher levels may be acceptable depending on sodium level and pH.
Sodium	32 mg/l	50 mg/l	Levels above 50 mg/l may affect performance if the sulfate or chloride level is high.

Table 2. Drinking Water Quality Guidelines for Poultry (cont.)

Contaminant or Characteristic	Level Considered Average	Maximum Acceptable Level	Remarks
Sulfate	125 mg/l	250 mg/l	Higher levels have a laxative effect. Levels above 50 mg/l may affect bird performance if magnesium and chloride levels are high.
Zinc		1.5 mg/l	Higher levels are toxic.

Sources: Adapted from T. A. Carter and R. E. Sneed, *Drinking Water Guidelines for Poultry*.
Poultry Science and Technology Guide No. 42, North Carolina State University
Marx and Jaikaran, 2007. Water Analysis Interpretation. Agri-Facts, Alberta Ag-Info Centre. Refer to http://www.agric.gov.ab.ca/app84/rwqit for online Water Analysis Tool Watkins, 2008. Water: Identifying and Correcting Challenges. Avian Advice 10(3): 10–15 University of Arkansas Cooperative Extension Service, Fayetteville

High levels of iron may encourage the growth of bacteria, which can lead to diarrhea. When the ferrous form of iron present in well water is exposed to the air, it is converted to the ferric hydroxide form commonly referred to as rusty water.

Other contaminants in the water may include pesticides, herbicides, industrial residues, petroleum products, and heavy metals such as lead or cadmium. Such contaminants are more difficult to detect and require more costly testing procedures.

Water Treatments

Various methods are available that can reduce or eliminate the impurities that adversely affect water quality. Options include the following.

Chemical treatments. Chlorination is a commonly used chemical treatment that is often employed for controlling bacterial contamination. Chlorine can be administered through an in-line proportioner. General recommendations are to have a level of 2 to 3 ppm at the drinker farthest from the proportioner. Chlorine levels can be easily monitored using a pool test kit.

Guidelines for Chlorination

- Do not chlorinate market age birds under extreme heat stress.
- Measure residual chlorine at the waterer to maintain at least a 1.0 ppm level at the drinker mid-house.
- Discontinue chlorination and administer powdered milk solution before vaccination to neutralize chlorine since chlorine can decrease the effectiveness of vaccines.
- Use caution since chlorine solutions are acidic and often oxidize soft rubber.

Softeners. Use water softening equipment to reduce hardness. Most softening equipment uses ion exchange to effectively remove the calcium and magnesium ions and replace them with sodium ions. Levels of TDS, however, are simply substituted and increases in sodium concentration of the water occur, possibly to unacceptable levels. Poultry are generally sensitive to increases in sodium levels, so producers should be judicial in their selection and use of water softening equipment.

Polyphosphates. Polyphosphates are chemical compounds used primarily to prevent the buildup of scale in the watering systems. They act to cause mineral contaminants to go into solution more readily.

Electrical/Magnetic Devices. Electrical or magnetic devices keep minerals associated with scale buildup in solution by altering their electrical charges.

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