

Drinking Water Quality for Poultry

Water is involved in every aspect of poultry metabolism. It plays important roles in regulating body temperature, digesting food, and eliminating body wastes. At normal temperatures, poultry consume at least twice as much water as feed. When heat stress occurs, water consumption will double or quadruple. A safe and adequate supply of water is therefore essential for efficient poultry production.

What are the characteristics of safe, good-quality drinking water for poultry? The answer to this question is often complex because the quality of drinking water can be evaluated in a number of ways. It can be tested for the presence of bacteria and other microbes, for the levels of minerals that occur naturally in the water, and for other chemical and physical factors. This guide describes the most useful indicators of water quality and tells how to take a water sample correctly to ensure accurate test results.

Interpreting Bacteria Test Results

If the number of microorganisms found in a water sample is too high, it indicates that the water supply is contaminated. Well water is normally tested for the total bacteria level, the coliform bacteria level, and occasionally for the fecal coliform bacteria level. Coliform bacteria are organisms normally found in the digestive tracts of livestock, humans, and birds. Their presence in water is used as a sign of fecal contamination.

Standards for animal drinking water indicate that there should be fewer than 100 bacteria of all types per milliliter (ml) of water and fewer than 50 coliform bacteria per ml (see Table 1). Recent field research indicates that a bacteria level of zero may be desirable to obtain optimum performance.

Causes of High Bacteria Counts

High bacteria counts in well water may be due to contamination from sources such as sewage treatment fields that are poorly designed, improperly constructed, failing, or located too close to the well. High counts may also result from poor well construction (particularly in the case of old or shallow wells) or poor maintenance if the well is not properly protected from surface drainage water.

For more information on well construction and maintenance, request copies of "Rules Governing the Protection of Private Water Supplies," Section 1700, from the North Carolina Department of Human Resources, Division of Health Services, Environmental Health Section, and "Well Construction Standards Criteria and Standards Applicable to Water Supply and Other Type Wells," North Carolina Administrative Code, Title 15, subchapter 2C, from the Environmental Management Commission, Environmental Management Division, North Carolina Department of Natural Resources and Community Development.

Controlling Microbial Levels

It is not advisable to use disinfectants to maintain safe bacterial levels in a highly contaminated well. Any disinfectant method is likely to fail at some time and expose the poultry to high levels of bacteria. The only sound approach is to eliminate the source of contamination. If that is not feasible, constructing a new well may be the best alternative.

Even if the water source has a low bacteria level, poultry may be exposed to the microorganisms that grow in waterers. Because these organisms can develop very rapidly, waterers should be cleaned properly each day. Chlorination or use of other disinfectants in the water along with good waterer cleaning is an effective way of controlling microbial levels.

Chlorination using an in-line proportioner (a device for accurately injecting the correct proportion of chlorine into the water line) has been successful in poultry operations if the residual chlorine level in the waterers is at least 1 milligram per liter (mg/l). Once the water is exposed to the air, however, the dissolved chlorine quickly dissipates. To accurately determine the residual chlorine level in the water that the poultry drink, the chlorine concentration should be measured using a standard test (such as the orthotolidine procedure) as soon as possible after samples are obtained from the waterers. Superchlorination or continuous treatment of the well with chlorine pellets can also be effective, but the level of chlorine in the drinking water must be controlled

because excess chlorine will cause poultry to lower their water consumption.

Use of an iodine-base disinfectant to control bacteria in drinking water is effective and provides more residual activity but is usually more expensive than chlorination. Be sure to use only approved chemicals at the recommended rates and ensure that the chemicals are compatible with watering equipment. Also, be sure to remove the disinfectant from the waterers and water lines before using a water vaccine or medication that is incompatible with the disinfectant.

Nitrates and Nitrites

Nitrates (NO_3) are produced during the final stage of decomposition of organic matter. Their presence in water usually indicates contamination by runoff containing fertilizer or human and animal wastes. Nitrates are soluble and may move with surface runoff or leach into the groundwater by percolation through the soil. Nitrates from sources such as animal and human wastes, nitrogen fertilizer, crop residues, and industrial wastes may move considerable distances in the ground. Nitrite (NO_2) is produced dur-

Table 1. Drinking Water Quality Guidelines

Contaminant or characteristic	Level considered average	Maximum acceptable level	Remarks
Bacteria			
Total bacteria	0/ml	100/ml	0/ml is desirable.
Coliform bacteria	0/ml	50/ml	0/ml is desirable.
Nitrogen Compounds			
Nitrate	10 mg/l	25 mg/l	Levels from 3 to 20 mg/l may affect performance.
Nitrite	0.4 mg/l	4 mg/l	
Acidity and Hardness			
pH	6.8-7.5	.....	A pH of less than 6.0 is not desirable. Levels below 6.3 may degrade performance.
Total hardness	60-180	.....	Hardness levels less than 60 are unusually soft; those above 180, very hard.
Naturally Occurring Chemicals			
Calcium	60 mg/l	.....	Levels as low as 14 mg/l may be detrimental if the sodium level is higher than 50 mg/l.
Chloride	14 mg/l	250 mg/l	
Copper	0.002 mg/l	0.6 mg/l	Higher levels produce a bitter flavor.
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.
Sodium	32 mg/l	.....	Levels above 50 mg/l may affect performance if the sulfate or chloride level is high.
Sulfate	125 mg/l	250 mg/l	Higher levels have a laxative effect. Levels above 50 mg/l may affect performance if magnesium and chloride levels are high.
Zinc .....	.....	1.50 mg/l	Higher levels are toxic.

Source: Schwartz, D. L., "Water Quality," VSE, 81c., Penn. State Univ. (mimeographed); and R. Waggoner, R. Good, and R. Good, "Water Quality and Poultry Performance," in *Proceedings AVMA Annual Conference*, July, 1984.

ing intermediate stages of the decomposition of organic compounds.

The toxicity of nitrates to poultry varies with the age of the birds, older birds being more tolerant. Levels in excess of 50 mg/l for chickens and 75 mg/l for turkeys have proven harmful in laboratory trials. A recent study with commercial broilers showed that nitrate levels greater than 20 mg/l had a negative effect on weight, feed conversion, or performance. Levels between 3 and 20 mg/l were suspected to affect performance. Nitrites are toxic at much lower levels than nitrates; concentrations as low as 1 mg/l can be toxic.

Well-drilling techniques have improved since many of the older, shallow wells were constructed. If nitrate or nitrite levels in your well water are too high and you cannot eliminate the source of contamination, drilling a new or deeper, properly constructed well may solve the problem.

Acidity and Alkalinity

The acidity or alkalinity of water is expressed as its pH level. Neutral water (that which is neither acid nor alkaline) has a pH of 7. Acidic water has a pH lower than 7 and alkaline water has a pH greater than 7. Well water normally has a pH in the range from 6.8 to 7.8, although it is not uncommon for the pH to be either higher or lower.*

In recent tests of 95 wells used for North Carolina poultry flocks, 16 percent had pH values below 6. Acid drinking water can affect digestion, corrode watering equipment, and be incompatible with medicines and vaccines. Field research indicates that drinking water with a pH lower than 6 can impair broiler performance. Water with a pH between 6.0 and 6.3 is suspected of having a negative effect.

Hardness

Although hard water may cause stains, leave residues, or cause other physical problems in water-handling equipment, hard water has not been demonstrated to have either a positive or negative impact on poultry performance. In treating hard water that is to be used as drinking water for poultry, however, care should be taken not to increase any existing chemical imbalance in the water.

Naturally Occurring Chemicals

A large number of chemicals occur naturally in well water. They are usually present in amounts that do not interfere with the metabolism or digestive func-

* In this publication the values that are given as "normal" are representative of those that one might expect to find in water used for drinking. They are not intended as averages or desirable target values.

tions of chickens or turkeys. When the levels of certain chemicals are out of balance, however, they can — by themselves or in combination with other chemicals — affect poultry performance.

Sodium. Excessive levels of sodium (Na) have a diuretic effect. The normal sodium level in water is about 32 mg/l. Studies indicate that a sodium level of 50 mg/l is detrimental to broiler performance if the sulfate level is also 50 mg/l or higher and the chloride level is 14 mg/l or higher.

Chloride. Consuming too much chloride (Cl) has a detrimental effect on metabolism. A chloride level of 14 mg/l is considered normal for well water. Studies have shown that a level of 14 mg/l in drinking water can be detrimental to broilers if combined with 50 mg/l of sodium. Chloride levels as high as 25 mg/l are not a problem if the sodium level is in the normal range.

Sulfate. High sulfate (SO₄) levels have a laxative effect. Levels of about 125 mg/l are regarded as normal for well water, but levels as low as 50 mg/l can have a negative effect on performance if either the sodium or magnesium level is 50 mg/l or more.

Magnesium. A symptom of a high magnesium (Mg) level is loose droppings. The normal level of magnesium in well water is about 14 mg/l. This chemical may interact with sulfate. Studies indicate that magnesium alone at 68 mg/l does not adversely affect broiler performance, but a level of 50 mg/l can be detrimental if the sulfate level is also 50 mg/l or greater.

Other Chemicals. Excessively high or low concentrations of other chemicals can produce recognizable symptoms. Excessive amounts of manganese (Mn) can produce a flavor problem. Too much copper (Cu) can give the water a bitter taste and may cause liver damage. High phosphate (PO₄) levels may indicate contamination from sewage. Calcium (Ca) does not seem to have any negative effect at levels as high as 400 mg/l, and it appears that a level of 35 mg/l or more may be desirable. High levels of iron (Fe) — up to 25 mg/l — have not been shown to be detrimental to broiler performance, although staining of waterers is evident at much lower levels. Guidelines for levels of iron, lead (Pb), and zinc (Zn) in drinking water are listed in Table 1.

Taking a Water Sample

The results of a water analysis will be reliable only if the samples are taken correctly. Your county health department will probably be willing to work with you in obtaining water samples and having them tested for bacteria and chemicals in the State Health Department laboratories. Commercial laboratories will also perform water tests for a fee. Be sure to specifically

request that your samples be tested for the chemicals and other factors that can be detrimental to poultry production as well as for the presence of microorganisms.

When you collect samples, remember that the water should first be allowed to run for several minutes to allow a representative fresh sample to reach the water outlet. The outlet should then be sterilized by flaming or other suitable method, and the sample should be placed in a sterilized container. The sample should arrive at the testing laboratory within 24 hours if bacteria tests are to be accurate.

Correcting Water Problems

If you are faced with a water quality problem, treating the water may help. It is best to give first priority, however, to finding the underlying cause for poor water quality and correcting the problem if possible. In some cases it may be necessary to find a different source of water.

For more information about water quality, ask your county Extension agent for a copy of *Water Quality Control* by Ronald E. Sneed, Extension Biological and Agricultural Engineering Specialist.

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