Poultry Water Quality

Susan Watkins, PhD
Center of Excellence for Poultry Science
University of Arkansas System's Division of Agriculture

Poultry are significantly influenced by water quality. Their crop or storage pouch is much better suited to whole seeds and grains rather than easily digested feed loaded full of nutrients including protein, fat, carbohydrates, vitamins and minerals. Feedstuffs can become foodstuff for bacteria when the water supplies are contaminated leading to potential health and production challenges. In addition, naturally occurring nutrients like iron, manganese and sulfur along with any added nutrients like vitamins, electrolytes and organic acids can significantly influence bacteria, mold etc. creating an opportunity for these microbes to thrive in water systems. This information provides a basic understanding of drinking water quality and quantity for poultry production as well as an interpretation of water test results.

TEST WATER SUPPLIES FOR BACTERIA AND OTHER CONTAMINANTS

The established guidelines for microbial and mineral water quality for poultry are outlined in Table 1. Note that CFU/ml means colony-forming units of bacteria/milliliter of water, and mg/l is also the same as parts per million or ppm. The microbial or bacterial test results you receive from labs are Total Plate Count of Aerobic (oxygen loving) Bacteria (TPC) as measured by CFU/ml. These results do not indicate whether the bacteria present is harmful or harmless but what it can tell you is if the system is dirty and therefore at risk for the presence of less desirable bacteria. If the total plate count or TPC level is 1000 CFU/ml or less then the water supply is considered acceptable. On farms with excellent water sanitation it is common to see water tests show 0 CFU/ml even from the end of the drinker line. The closer your water sample results are to 0 CFU/ml the better your water supply is for the modern commercial chicken or turkey. Should the test results be greater than 10,000 CFU/ml, it is strongly recommended that the water system be thoroughly cleaned between flocks with an approved cleaner at appropriate concentrations and length of time and then a daily water sanitation program implemented when birds are present.

Chlorine is the cheapest water sanitizer available and typically works well but other products such as chlorine dioxide and hydrogen peroxide are also available and used successfully. Target levels of chlorine are 3-5 ppm but there have been farms that reported it necessary to run levels higher to help prevent disease issues. There are also farms that after thoroughly cleaning water systems are finding that as little as .5-1 ppm of chlorine is adequate for optimal water sanitation. It is important to test for free and total chlorine levels. When the total is much higher than the free chlorine, then it indicates that the system contains either organic material or biofilm and/or minerals that are tying up part of the chlorine residual. Ideal is when the free and total chlorine readings are very similar. That indicates the system is clean. Target levels of chlorine dioxide are 0.8 ppm but higher levels (2-7 ppm) may be required for effectiveness and target levels of hydrogen peroxide are 25-50 ppm in the drinking water. Monitor your sanitizer residual to assure residual levels are adequate.

If your water test is performed by the Department of Health, the results will be total coliforms. Coliforms are a good indicator organism that lets us know if a water supply has been contaminated by livestock (runoff from concentrated animal production areas) or human waste

(failed septic system). Should your water supply contain more than 50 CFU/ml coliforms it is definitely a good idea to treat the water supply possibly with shock chlorination which involves pouring a concentrated bleach solution down the well head then flushing it out. In addition, look for possible sources of contamination and correct the problem to prevent recontamination. Staphylococcus Enterococcus is becoming a more widely accepted organism for monitoring in public waterways used for drinking and recreation so consideration should be given for testing for its presence on a scheduled basis. Never assume that water remains good through poultry house water systems. It is also important to note that water borne illnesses can stem from numerous pathogens that are adapted to water supplies. If problems are suspected or confirmed, a thorough cleaning of the water system including the underground distribution pipes should be conducted and it may take cleaning more than once between flocks to eliminate issues.

When unsure of water quality, test supply at the source and at the end of a water line in a barn farthest away from the source. Results from previous water tests (Table 2) show just how dramatically water quality can change even over the course of a few hundred feet. Additionally, swab water lines to thoroughly understand if quality is compromised.

Use the following guidelines to determine when water supplies should be tested:

- Noticeable change in color, odor or taste
- Flooding has occurred near well
- Person or animal becomes sick from waterborne disease
- Maintenance on water supply system
- Persistent poor performance with no explainable reason
- Loss of pressure in water system (power failure to well)

MINERAL TESTS

There is no such thing as pure drinking water supplies as all sources have some amount of minerals dissolved in it. The majority of the time, these dissolved minerals are well within acceptable ranges but unfortunately there are many cases of contaminants that are not within desired levels which results in the following issues:

1) Poor performance
2) Equipment failure or damage
3) Presence of harmful bacteria or fungal slime (some minerals can act as a food supply for these).

Contaminants are measured as mg/liter or ppm which is equal to one gallon of sugar dissolved into a million gallons of water. That would give 1 ppm of sugar. Although parts per million (ppm) of anything seems quite small, remember, the birds already receive a balanced diet and if they are also receiving high levels of such nutrients as sodium (Na) or chloride (Cl) i.e. salt in the water, then over time the birds may exhibit poor performance because they just have more than their systems can handle. In addition, water contaminants can also impact how nipple drinkers work or water distribution. Even a fine buildup of mineral residue on seals, rims, filters or screens (at pressure reducer) could be all that is necessary to limit water flow and thus result in less than adequate consumption for optimum bird growth and feed conversion or just as bad, wet floors. Wet floors lead to cocci and other disease challenges.

Quantity

Modern flocks have more than doubled their water consumption in the last twenty years according to statistics collected and analyzed by the University of Arkansas Division of Agriculture Poultry Science Applied Broiler Research Farm (Table 3). (Williams et al. pending pub.)

Restriction points can include

- Clogged pressure reducer screens
- Inadequate pipe size including distribution from well/source to houses and inside house lines
- Improper management of drinker regulator pressure
- Failure of drinker line regulators to work properly
- Pinch points such as hose size feeding to regulators, medicators, filters, pipe angles and mineral deposits
- Gallons per minute capacity

Conclusion

Water is the most essential nutrient birds receive, yet the quality is often taken for granted. Providing flocks with a clean, wholesome supply can make a difference in performance. Develop a water profile for your operation. Have water checked twice annually to benchmark water quality changes in microbial or mineral content for at least for two consecutive years unless additional circumstances warrant further testing. Should water be a suspect for flock problems, make arrangements to have water tested for total bacteria numbers as well as for mineral content. While total aerobic plate count won't tell exactly what is in the water, it is an indicator of excessive levels of bacteria that should be addressed. By promoting a regular water sanitation program on farm, producers can prevent environments in water systems that could lead to poor bird performance. By monitoring water consumption and implementing a good equipment maintenance program along with monitoring flock daily water consumption, producers can prevent water issues that can lead to costly problems.

Table 1. Water Quality Standards for Poultry

Contaminant, mineral or ion	Levels considered average	Maximum Acceptable Level	Comments
Bacteria Total Bacteria (TPC) CFU/ml Total Coliforms Fecal Coliforms	 0 CFU/ml 0 CFU/ml 0CFU/ml	 1000 CFU/ml 50 CFU/ml 0 CFU/ml	Total Bacteria is used as an indicator of system cleanliness, high numbers do not necessarily mean the bacteria present is harmful but it does mean that the system is capable of harboring pathogenic organisms. High bacteria levels can impact taste of water resulting in reduced consumption by birds Shock well then implement sanitation program such as gas chlorine, hydrogen peroxide or other sanitizers. Maintain a residual Presence of any fecal coliform means water is unfit for consumption by poultry or humans
pH	6.5-7.8	5-8	pH below 5 can be harmful to drinker equipment-causing corrosion to metal components with long term exposure pH above 8- impacts effectiveness of most water sanitizers and if high pH is also associated with high alkalinity, may result in reduced water consumption in poultry due to "bitter" taste. If pH is lower than 5 soda ash or caustic soda injection will raise pH. If pH is high acid injection will be required.
Total Hardness	60-180 mg/l	110 mg/l	Hardness can also be determined by adding the Calcium and Magnesium content, Hardness causes scale which can reduce pipe volume and cause drinkers to be hard to trigger or leak Softeners can remove compensated hardness up to a practical limit of 100 gpg or 1710 ppm /mg/l If the hardness is above 30 gpg or the sodium to hardness ratio is greater than 33% then the sodium level will be high after softening and reverse osmosis may be required .Phosphate injection will sequester the hardness.
Natural Elements			
Calcium (Ca)	60 mg/l		No upper limit for calcium, birds very tolerant of calcium but if values above 110 mg/l may require water softener, polyphosphates or acidifier to prevent scaling
Magnesium (Mg)	14 mg/l	125 mg/l	Higher levels of Mg may cause flushing due to laxative effect particularly if high sulfate present
Iron (Fe)	.2 mg/l	.3 mg/l	Birds tolerant of iron metallic taste but iron causes leaking drinkers and promotes the growth of E coli and pseudomonas and is linked to a thick slime producing bacteria such as crenofroms , Treatment includes oxidation with chlorine, chlorine dioxide or ozone and then filtration

Manganese (Mn)	.01 mg/l	.05 mg/l	Can result in black grainy residue on filters and in drinkers, Treatment includes oxidation with chlorine, chlorine dioxide or ozone then filtration, green sand filtration and softeners will remove Mn make sure you pay close attention to pH when deciding what method to use. There has been a trend through the years to see problems on farms with manganese in the water
Chloride (Cl)	50 mg/l	150 mg/l	When combined with high sodium levels, creates salty water that can act as a laxative causing flushing, also, salty water can promote the growth of *Enterococci* organisms that can lead to enteric issues Treatment- Reverse Osmosis, anion exchange resin, lower dietary salt level, blend 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	When combined with high chloride levels, creates salty water that can act as a laxative causing flushing, also, salty water can promote the growth of enteroccoci organisms that can lead to enteric issues or possibly kinky back?? Treatment- Reverse Osmosis; lower dietary salt level; blend source with non-saline water; Keep water clean and use daily sanitizers such as hydrogen peroxide or iodine to prevent microbial growth
Sulfates (SO4)	15-40 mg/l	200 mg/l	Sulfates can cause flushing in birds. If rotten egg odor present, then bacteria producing hydrogen sulfide are present and system will require shock chlorination plus establishment of good daily water sanitation program, sulfates can be removed by reverse osmosis or anion resin. If H2S is present (the rotten egg smell) than aerating water into a holding tank, treatment with sanitizers then filtration
Nitrates	1-5 mg/l	25 mg/l	High nitrate levels can result in poor growth and feed conversions. Plus presence of nitrates may indicate fecal contamination so also test for bacteria Can be removed with Reverse Osmosis; Or anion exchange resin.
Lead	0 mg/1	.014 mg/l	Long term exposure can cause weak bones and fertility problems in breeders and turkeys. reverse osmosis ,softener or activated carbon will greatly reduce the lead
Copper	.002 mg/l	0.6 mg/l	
Zinc		1.5 mg/l	

Table 2. Drinking water Total Bacteria Levels Found at Source and End of Water Lines

Farm	Sample Location	CFU/ml
A	At source	2,700
	End of water line	26,600
B	At source (community water line)	203,000
	End of water line	2,340,000
C	At source	600
	End of line	282,000
D	At source	0
	End of line	4,775,000

Table 3. Comparisons of broiler water consumption over the past twenty years

Bird Age (Day)	2010-2011 Year Flocks	2000-2001 Year Flocks	1991 Year Flocks
		Gallon/1000 broiler birds	
1	0	0	0
2	5.85	3.16	2.25
3	7.81	5.56	4.96
4	11.10	8.06	6.23
5	13.39	9.97	6.87
6	15.30	11.60	8.15
7	17.67	13.17	10.75
8	21.03	15.41	10.87
9	22.57	17.70	13.02
10	24.88	19.91	15.10
11	27.73	21.48	16.89
12	28.96	23.70	17.00
13	32.23	25.29	21.05
14	34.80	27.55	21.88
15	35.96	29.63	24.61
16	38.17	31.50	24.89
17	40.55	32.97	27.39
18	42.87	34.66	28.98
19	45.99	36.49	29.21
20	47.90	38.29	31.89
21	50.22	40.27	36.03
22	52.21	41.36	39.65
23	52.65	43.39	39.37
24	56.77	46.31	41.98
25	58.94	49.01	41.96
26	60.28	50.67	44.00
27	61.46	52.28	47.56
28	63.51	54.41	49.02
29	66.16	57.30	48.34
30	70.59	56.97	52.29
31	70.73	61.16	55.92
32	72.10	65.25	58.47
33	75.17	64.10	56.77
34	73.31	67.07	61.63
35	75.79	69.14	62.08
36	75.64	70.97	63.90
37	80.38	73.05	62.99
38	82.77	74.70	63.79
39	82.91	77.87	66.83
40	82.47	77.75	67.04
41	84.88	78.16	71.85
42	84.34	80.14	71.72

Table 1: Numerical average daily water consumption (gals/1000 birds) by bird age for Present, 10-year and 20-year flocks.

References

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