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College of Agricultural Sciences • Cooperative Extension

School of Forest Resources

Water Facts #12

Interpreting Drinking Water Tests for Dairy Cows

(Note: Although this fact sheet focuses on dairy cows, the water quality criteria explained for each parameter are applicable to most farm animals.)

Today's dairy cows may consume more than 20 gallons of water per day, yet water is often overlooked as a potential cause of herd health issues or reduced milk production. Experience has shown that aesthetic pollutants, such as iron, manganese, and hydrogen sulfide, are the most common causes of problems with dairy herds. These pollutants cause tastes or odors that result in lowered water intake and less milk production. Less common but more serious problems can be caused by health-related pollutants such as bacteria, nitrate, or heavy metals. This fact sheet describes some of the common water pollutants found in rural water supplies in Pennsylvania and their potential effect on dairy cows.

pH

The pH of drinking water for dairy cows should fall between 5.1 and 9.0. Acidic water with a pH less than 5.1 may increase problems related to chronic or mild acidosis, causing reduced milk production, depressed milk fat test, poor gains and growth, lower feed intake, and more infectious and metabolic problems. Alkaline water with a pH above 9.0 may result in problems related to chronic or mild alkalosis, causing symptoms similar to mild acidosis. Alkalosis may also interfere when rations contain excessive amounts of protein, minerals, and buffers, especially rations high in alfalfa.

Total Dissolved Solids (TDS)

TDS is a sum of all of the inorganic contaminants in water. Drinking water with less than 1,000 milligrams per liter (mg/L) of TDS is ideal for dairy cows. Levels of 1,000 to 3,000 mg/L are usually satisfactory. Levels above 3,000 mg/L are more likely to cause bad-tasting water, which may result in reduced water intake and milk production. High-TDS water may also cause symptoms of dehydration and electrolyte imbalance. Water with a high TDS above 3,000 mg/L often has high hardness, chloride, and/or sulfate (see explanations of these tests below).

Nitrate-Nitrogen and Nitrite-Nitrogen

Although nitrate-nitrogen levels as low as 10 mg/L can be harmful to humans, research has shown that much higher levels of nitrate-nitrogen up to 100 mg/L can be tolerated by cattle. Levels of 100 to 300 mg/L may cause reproductive problems in adult cattle and reduced gains in young stock, depending on nitrate intake from forages. Nitrate-nitrogen levels above 1,000 mg/L may result in acute symptoms and death.

Nitrite-nitrogen concentrations as low as 1.0 mg/L have been reported to be toxic to dairy cattle, but nitrites above this level are rarely found in water. Nitrite toxicity causes symptoms similar to high nitrate intake from feed and/or water, infertility, including abortions at very high intakes, reduced gains and growth, respiratory distress due to lack of oxygen, gray-brown mucous membranes, and chocolate brown-colored blood.

Hardness, Calcium, Magnesium

Hardness is mostly a measure of the calcium and magnesium in water. Hard water causes many aesthetic problems with the use of the water but generally does not adversely affect cows. Excessive amounts of individual minerals can be problematic. For example, calcium concentrations above 500 mg/L in water should be included in ration formulation. Water with more than 125 mg/L of magnesium may cause laxative effects and should also be included in ration formulations. Concentrations of magnesium below 100 mg/L may still cause laxative effects if the sulfate level in the water is relatively high (above 250 mg/L).

Sodium

Sodium in water is rarely problematic for dairy cattle, but sodium concentrations should be included in the formulation of anionic rations if levels exceed 20 mg/L. High sodium usually results from deicing salts, softener recharge brines, or gas well brines.

Iron and Manganese
Iron and manganese are very common pollutants that can occur naturally in groundwater or from nearby mining activities. Both cause severe staining and a metallic taste to water, resulting in reduced water intake and reduced milk production. Iron levels above 0.3 mg/L and manganese concentrations exceeding 0.05 mg/L are sufficient to cause unpleasant tastes in water. These metals do not cause any direct health effects to animals.

Chloride
Chloride in water may originate from brines during gas and oil well drilling or from road-deicing salts. Chlorides above 250 mg/L will impart a salty taste to water, causing reduced water intake, dehydration, and reduced milk production.

Sulfate
Sulfate concentrations above 250 mg/L can cause diarrhea and mineral imbalances, especially in young animals. Adult animals may also have reduced milk fat when exposed to water with high sulfate concentrations above 500 mg/L. High sulfate levels may also increase needs for selenium, vitamin E, and copper. Over time, some animals become acclimated to elevated sulfates in water, resulting in reduced symptoms.

Copper
Copper usually occurs in water from corrosion of metal plumbing components. It may also be elevated in mining areas or from treatment of ponds with copper sulfate algaecides. Copper levels above 1.0 mg/L may cause a metallic taste, resulting in reduced water intake and milk production. High copper concentrations may also cause liver damage.

Coliform Bacteria
Coliform bacteria occur in all surface waters (streams, ponds, etc.) and many groundwater wells. Coliform bacteria in wells usually come from surface water contaminating the well or from insects under the well cap. Water used for washing equipment, udders, and teats should have zero total coliform bacteria per 100 mL of water.

There is much less certainty about the effect of coliform bacteria on drinking water for dairy cows. Past studies have suggested that drinking water for cattle should have fewer than 50 coliform bacteria per 100 mL of water because of potential calf problems and losses, more off-feed, ketosis, or acetonemia problems with cows, chronic or intermittent diarrhea, liver damage, and increased infections. However, more recent research in Pennsylvania was unable to show a correlation between bacteria and herd health issues. Also, the concentration of coliform bacteria is strongly related to where the water is collected. Water samples from drinking troughs will often have large concentrations of coliform bacteria, especially if the troughs are cleaned infrequently. Samples collected at drinking areas compared to the source well water will indicate the need for better sanitation. Clean and sanitize drinking cups, bowls, and tanks daily to reduce bacteria loads. Use a raised base around bowls or tanks to reduce manure contamination of drinking water.

***E. coli* Bacteria**
E. coli bacteria occur from direct contamination by animal or human waste. As such, the occurrence of *E. coli* bacteria is much more serious than total coliform bacterial contamination. *E. coli* bacteria should be absent from drinking water for cattle.

More Information
More details on management of private water supplies, consult the Penn State Water Resources Extension Web site at: http://water.cas.psu.edu/.

Sources
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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available in alternative media on request.

CODE XH0021