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The importance of Water Quality and Intake on Dairy Farms

Water

It is worth repeating: Water is one of the most important, yet often neglected, nutrients for the cow. Water intake is related to animal size, age, activity, productivity and environment. It is important to measure water intake on the farm and compare with research estimates. Lack of water intake will reduce dry matter intake and production. To maximize water intake, maintain adequate water pressure and water availability, offer warm water, avoid stray voltage, and add water to the total mixed ration. Cleanliness, bacteria, chemicals, and minerals affect water quality. Poor water quality reduces water intake. Cows are more sensitive than people are to water quality problems.

Water ranks second only to oxygen in importance to the cow yet it is the most often neglected nutrient on the dairy farm. Both water quality and water intake are important. **Often, water quality will impact water intake**. Water quality can also affect cow health and productivity in other ways. Rations can be perfect on paper but even with apparently small water problems, cows can be down in milk by 10-20%! Cows need water to maintain their blood volume, to keep organs and tissues functioning, and to aid in digestion and absorption of feed. Since milk is 87% water, milk production is partly a function of water intake.

Water Intake

Daily intake of water will vary according to an animal's age, size, level of activity, and level of productivity. Environmental temperature, humidity, water availability, and water quality can also impact water intake. It must be recognized that a portion of the cow's water comes from her ration. Less water will be drunk from the water tank, as the ration gets wetter. Holstein cows need about 4 pounds (one-half gallon) of water to make a pound of milk. Therefore, a cow making 100 pounds of milk per day needs to consume about 400 pounds of water per day. If she eats 110 pounds of her ration that is 50% moisture, she will get 55 pounds of water from the ration and will need to actually drink 345 pounds of water (41 gallons/day).

The estimate of about 4 pounds (one-half gallon) of water to make a pound of milk is in fairly close agreement to what the author has seen measured for Holsteins on commercial dairy farms in the northeastern U.S. However, in the research literature and nutrition books, a number of different estimates for water intake can be found. It can be confusing, especially since it is not always apparent if the estimates are for total water intake or for just drinking water intake.

Dr. Al Kertz of the Ralston Purina Company developed the following equation for estimating water intake. It is slightly more complicated that the 4-pound of water per pound of milk rule. It accounts for differences in dry matter intake and fat content of the milk produced. It is probably better to use, especially for different breeds of cows.

Total water intake (lbs/day) =
(4 x dry matter intake) + pounds of 4% fat-corrected milk (FCM) + 25.6
where: 4% FCM = (0.4 x lbs milk) + [15 x (%fat ÷ 100) x lbs milk]

Example: 1300-pound cow producing 100 pounds of 3.5% milk (92.5 pounds 4% FCM) eating 110 pounds of a ration which is 50% moisture
(4 x 55) + 92.5 + 25.6 = 338.10 pounds/day of total water intake

Lack of water intake will reduce a cow's dry matter intake. So, wrong conclusions may be drawn from Kertz's equation if poor water intake is driving down dry matter intake. One has to ask which came first, the poor water consumption or the poor intake?

Temperature can affect water intake. The table below shows the differences in drinking water intake at various environmental temperatures.

Estimated Drinking Water Intake of Dairy Cattle at 40°, 60°, 80°F

	Drinking Water Intake at 40°F (gal/day)	Drinking Water Intake at 60°F (gal/day)	Drinking Water Intake at 80°F (gal/day)
Heifer, 200 lbs	2.1	2.4	3.2
Heifer, 400 lbs	3.2	4.5	6.1
Heifer, 600 lbs	6.3	7.9	10.5
Heifer, 1200 lbs	8.7	10.8	14.5
Dry Cow, 1400 lbs	9.7	11.8	16.1
Milking Cow, 1400 lbs, 60 lbs milk	21.8	23.9	24.7
Milking Cow, 1400 lbs, 80 lbs milk	26.8	31.8	38.7
Milking Cow, 1400 lbs , 100 lbs milk	31.8	37.1	45.5

(Adapted from Eastridge and Watson, 1990)

(The chart shows average drinking water consumption of cows fed a ration with average moisture (45-55%)

Note: 1 gallon = 8.34 pounds of water

More research needs to be done in the area of water intake, especially in today's high producing dairy cattle. However, in practical situations on farms, it is still recommended that water intake be measured and tracked especially if production is down for no other obvious reason. Water flow meters can be installed in water lines or known amounts of water can be provided in water tanks and the amount consumed can be measured. Be careful to adequately assess the impact of calves, heifers or dry cows that may also be consuming water from the same source as the milking cows in a barn. Also, don't include water used in the milk house. Measure and calculate the average water intake over at least a week before drawing any conclusions. Measure daily temperature and correlate it to water intake. One cubic foot of water weighs 62.4 pounds.

As a general rule, water consumption should not be more than 15-20% less than the research estimates described above. For example, if I were working with a herd with the potential to make at least 70 pounds of milk per day and consuming about 6 gallons per day in the ration, I would be concerned if drinking water intakes were less than 22-23 gallons per cow per day.

Besides production, digestion and reproduction problems, some visible signs of water intake problems include: cows lapping at water, blowing bubbles in water, and hovering over the water tank.

Maximizing Water Intake on the Farm

Dairy producers and their consultants need to always be aware of management factors that could reduce water intake on the farm. They also need to always be thinking of new and creative ideas for increasing the amount of water that cows consume.

Maintain Adequate Water Pressure and Water Availability - Cows want to drink the most right after meals and after milking. Water bowls should provide 1 to 2 gallons per minute and water tanks should supply 2 to 4 gallons per minute. A water tank at least three feet long and two feet wide is needed for every 20 cows in a group. This is a general recommendation but it should be noted that many dairy producers, especially those in warm climates, exceed this recommendation and feel that their cows respond positively.

Like people, cows prefer to eat, then drink, eat, then drink, etc. Water tanks need to be easily accessible, at least 50 feet (15 meters) from the feedbunk. Ten to twelve feet is needed around the water tank to reduce pushing and shoving. Many farmers have installed extra water tanks near the parlor exit or they have put water in the parlor.

It has been shown that cows will drink more slowly from water bowls than from tanks. Some farmers with tie-stalls have taken out water bowls and installed small water troughs in front of cows. They have seen production responses.

Offer Warm Water - Cows prefer warmer water (80o- 85oF). Many dairy producers use their milk cooling system to warm water offered to cows.

Avoid Stray Voltage - Stray voltage doesn't help water intake. Over 3-4 volts can cause cows not to drink and as little as ½ volt has reduced water intake.

Add Water to the TMR – Bringing the moisture level up to 55-57% using added water in TMR's may increase total water intake and reduce the potential for cows to sort their rations.

Clean Water

Don't forget that the simple act of cleaning water tanks at least once per week can make an impact on milk production. As you walk by a water tank, ask yourself, "Would I drink that water?" If the answer is "No", it needs to be cleaned. Disinfect water tanks by scrubbing with ½ cup bleach in 5 gallons of water.

Water Quality

Water quality can be reduced with high levels of bacteria, chemicals, organic matter, and minerals. Unfortunately, sometimes what the book says is a tolerable level of contamination still hurts the cow. Cows are often more sensitive than people are to water quality problems. More research is definitely needed in this area. Because of this, if I suspect that water quality is compromising water intake, I usually prefer to try an alternative water source for a week or two and evaluate milk response. If the cows come up in milk on the new water supply, then it is time to spend money on intensive water analysis, water purification systems, or a new well. If I suspect bacterial contamination or that mineral levels could be causing reproductive problems then, of course, a basic water analysis is done right away.

When sampling water for analysis, take the sample at the same place where the cow would drink it. Take it from the cow's water tank or water bowl, not back at the well. Proper sample handling is essential. Use containers supplied by the water-testing lab. Samples to be analyzed for bacteria should be kept cool (on ice) and delivered to the lab within 6 hours.

It is recommended that water be analyzed at least once per year regardless of perceived problems. Maintain good records of water analysis from year to year so that you can prove when contamination occurred, if necessary.

High sulfate and high iron are common problems. High sulfate will smell like rotten eggs. Iron can give water a metallic taste. These minerals can reduce palatability and reduce the absorption of other dietary minerals, most notably copper, zinc, and selenium. Reductions in the availability of these trace minerals can result in poor reproductive performance in cows, sometimes without any effect on water intake. High water sulfate combined with low levels of dietary copper has been found to cause polioenphalo-malacia (PEM). This is a thiamin deficiency that is evidenced by weakness and loss of coordination. The animal's head may bend backward and death can occur. It is more common in calves.

Filters can be installed to remove high levels of minerals from the water through ion-exchange or demineralization processes. An alternative to filtering would be to add more trace minerals, preferably the more available organic minerals, to the ration. Probably, over the long run, filtering is more economical. Water softeners remove calcium and magnesium. Iron can be removed by a water softener but it damages the softener at levels above 2 ppm. A greensand filter can remove moderate amounts of iron (up to 12 ppm).

Bacteria, both coliform and soil-borne, can be a problem. Iron-loving or sulfur-loving bacteria can also be a problem. Chlorine can be used to kill bacteria but be careful not to over-do it. Levels of 0.3 to 0.7 ppm should be effective for bacterial control. Many farmers have testified to milk losses with chlorine greater than 1.0 ppm in water. Some nutritionists speculate that this level of chlorine can inhibit the rumen microbes and reduce fiber digestion. Dairy producers have had problems even with chlorinated city water. Another means of controlling bacteria in water is by ultraviolet radiation.

Water pH should at least be between 5.5 and 8.5. The closer to 7.0 the better. Water pH outside of this range can cause acidosis or alkalosis (symptoms similar to acidosis). Water pH can be corrected by installing neutralization systems.

High levels of nitrate (NO_3) in water can result in nitrate poisoning. Nitrate is converted to nitrite in the rumen. Once nitrite is absorbed from the rumen, it can decrease the blood's ability to carry oxygen. This can eventually kill the cow. Fertilizer or fecal matter (both human and animal) can cause water nitrate problems. It is difficult treat water contaminated with nitrate. It is often easier to correct the contamination problem or find a new water source.

Palatability of water may be reduced when water contains some minerals at lower levels than what is considered to be harmful. According to Mancl(1995), the levels of the following minerals or chemicals can cause taste or smell problems: chloride (250 ppm), iron (0.1 ppm), phenol (0.001 ppm), total dissolved solids (500 ppm), surfactant (soap) (0.5 ppm), and zinc (5 ppm). There will be more strep than coliform if pollution is from animals

Water Analysis

Chemical	**Possible Cattle Problems** (> means "greater than")
PH	Under 5.5, Over 8.5
Dissolved Solids	>3,000 ppm
Total Alkalinity	>5,000 ppm
Sulfate	>250 ppm may have laxative effect >2000 ppm can be a problem
Fluoride	>1.5 ppm (Mottling of teeth)
Calcium	>500 ppm
Magnesium	>125 ppm (May be a laxative)

Iron	>0.3 ppm (should be able to taste)
Manganese	>0.05 ppm (should be able to taste)
Copper	>0.5 ppm
Arsenic	>0.20 ppm
Cadmium	>0.05 ppm
Mercury	>0.01 ppm
Lead	>0.10 ppm
Nitrate as NO_3	>100 ppm
Nitrate as N	>23 ppm
Nitrite as NO_2	>4 ppm
Hydrogen Sulfide	>0.1 ppm (should be able to taste)
Chromium	>1.0 ppm
Cobalt	>1.0 ppm
Nickel	>1.0 ppm
Barium	>10 ppm
Zinc	>25 ppm
Total Bacteria/100 ml	>1,000,000
Total Coliform/100 ml	>1, calves; >15-20, cows
Fecal Coliform/100 ml	>1, calves; > 10, cows
Fecal strep/100 ml*	>3, calves; > 30, cows

Adapted from Ruppel (1994), Adams (1986), Grant, Beede (1992), Mancl (1995)

* Fecal coliform should be several times higher than fecal strep if pollution is from humans.

Source: DeLaval - http://www.milkproduction.com/Library/Scientific-articles/Housing/Water/

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