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Water Quality and Requirements for Dairy Cattle

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This NebGuide stresses the importance to the dairy cow of water, an essential but often overlooked nutrient.

Providing insufficient water or water of poor quality to dairy cattle can limit milk production and growth, and can cause health problems. An adequate supply of clean water promotes normal rumen function, high feed intake, digestion, and nutrient absorption. Water also maintains blood volume, supplies tissue needs, and makes up about 87 percent of the milk secreted by the cow. The following sections discuss water intake and requirements, water quality, and guidelines for proper use of cattle waterers.

Water Intake and Requirements

The expected daily water intake for different classes of dairy cattle is shown in *Table I*. Even a small limitation in water intake will decrease dry matter intake by 1–2 pounds daily, which could limit peak milk production by 2–5 pounds. Lactating dairy cows require 4.5–5 pounds of water per pound of milk produced. This equates to roughly one-half gallon of water for every pound of milk secreted. As an example, a cow producing 100 pounds of milk daily could consume as much as 50 gallons of water. Remember that daily water intake comes from both drinking and moisture (water) in the consumed ration. For example, if a ration contains 40 percent moisture, it contains 40 percent water. That means a cow eating 80 pounds of this ration daily would be consuming 32 pounds of water (80 pounds × 40 percent moisture = 32 pounds of moisture, or water).

Some of the factors that affect drinking behavior include the cow's eating patterns and ease of access to the watering area, the temperature of the water, whether the water is in a trough (tank) or a water bowl, cow dominance if water bowls are shared, and stray voltage.

Eating pattern. Cows have peak water intake during the hours when feed intake is greatest. When given the opportunity, cows tend to alternately consume feed and drink water. Ideally, fresh, clean water should be available to the cow whenever she consumes feed. Additionally, cows often seek water after milking; thus it is advisable to have ample sources of water available in spaces where cows may be passing after milking.

Water temperature. In a cold environment, most cows will prefer liquid water to snow or crushed ice. Therefore, to promote adequate water intake, it is important to keep waterers and water tanks or troughs open and relatively

Table I. Drinking water requirements of dairy cattle.[1]

Livestock class	Age or Production	Gallons/day[2]
Calves	1 month	1.3 to 2.0
	2 months	1.5 to 2.4
	3 months	2.1 to 2.8
	4 months	3.0 to 3.5
Heifers	5 months	3.8 to 4.6
	15 to 18 months	5.9 to 7.1
	18 to 24 months	7.3 to 9.6
Holstein cows	Lactating	18.0 to 40.0
Dry cows	Pregnant, 6 to 9 months	9.0 to 13.0

1. Adapted from: Swistock, B. 2016. Interpreting Drinking Water Tests for Dairy Cows. Pennsylvania State University.

2. Higher levels of water intake apply for an all-hay ration (greater than or equal to 80 percent dry matter).

Table II. Possible causes of inadequate water intake.

Primary cause	Specific problems
Lack of supply[1] to drinking devices	Corroded valves
Inadequate system pressure	Need 2 pounds minimum pressure
Poor chemical quality	Very acidic or alkaline Hydrogen sulfide (rotten egg odor) Metallic taste from iron High dissolved solids content
Pollution[1]	Coliform bacteria from manure, algae growth Chemicals
Stray voltage	Drinking devices Surface that cow stands on
Poor cow access to waterers	Poor waterer placement; slippery, muddy surfaces; cow overcrowding

1. Sites in the water supply that can become polluted include the source (e.g., well, spring), pressure tank or reservoir, and the drinking device with feed or manure.

free of ice during winter months. Research on drinking chilled water (about 50°F) has given mixed results in lactating dairy cattle. In some studies, cows consumed more chilled water with no effect on feed intake or milk yield. However, other studies have shown that cows drink less chilled water, but that milk yield is higher. Practically, it may not be economical for most Nebraska dairy producers to consider chilling water, given the expense and variable responses.

Type of waterer. Cattle generally have fewer drinking bouts with water troughs (tanks) compared with water bowls. In a British study, time spent drinking ranged from 2–8 minutes daily, with higher drinking times usually associated with use of water bowls. However, the drinking rate can vary from 10–30 pounds per minute, with lower rates generally found for cows using water bowls.

Cow dominance. Research has shown that submissive cows use a water bowl less frequently than their more aggressive partner using the same bowl. These cows consume less water and feed, and produce milk with less milk fat. Social interactions such as this may be important for producers who house their cattle in stanchion or tie stall barns where pairs of cattle share a common water bowl. Sometimes, simply moving cattle from one stall to another can eliminate the problem.

Stray voltage. Research at Cornell University indicates that cows subjected to three or less volts of alternating current between the water bowl and hind feet adapted within two days with no change in water consumption. Beyond 3–4 volts, however, many cows refused to drink. However, field observations indicate that voltage above one-half volt can cause a decrease in water consumption in some animals. Thus, from a practical standpoint, stray voltage in excess of one-half volt could lead to water consumption problems.

Calf requirements. Calves fed milk replacers with high levels of magnesium may have a higher incidence of kidney and bladder stones. Higher than necessary magnesium levels can either come from the replacer or from higher than normal levels in the water. The National Research Council (2001) recommends .07 to .08 percent magnesium on a dry basis for milk replacers. Also, recent evidence suggests that calf performance can be improved by giving calves free access to water early in their lives. Feed intake is related to free water intake in young calves, and in general the ration of free water intake to feed intake 4:1 (on a weight-to-weight basis where feed intake is on a dry matter basis). Water intakes may be higher when air temperatures are over 80°F, and lower than expected when air temperatures fall below 50°F, and much less at very cold temperatures. *Table II* lists some of the major causes of poor water intake by dairy cattle.

Signs of Inadequate or Excessive Water Intake

Low water intake results in low urine output and constipated, firm manure. This may also be a symptom of dehydration from disease or fever. Restricted water intake leads to reduced milk yield and may promote intestinal disease if cattle drink from puddles of water containing urine. Note that lack of salt, potassium, and crude protein in the ration may also cause this behavior.

Excessive water intake leads to excessive urine production, abnormally loose manure, and a relatively bloated

Table III: Analysis of water supplies[1]

Item	Average	Expected[2]	Possible Cattle Problems
pH	7.0	6.8–7.5	Under 5.5; over 9
	(ppm)	(ppm)	
Dissolved solids	368	500 or less	Over 3,000
Total alkalinity	141	0–400	Over 5,000
Sulfate	36	0–250	Over 2,000
Fluoride	0.23	0–1.2	Over 2.4
Calcium	60.4	0–43	Over 500
Magnesium	13.9	0–29	Over 125
Iron	0.8	0–0.3	Over 0.3 (taste)
Manganese	0.3	0–0.05	Over 0.5 (taste)
Copper	0.1	0–0.6	Over 0.6 to 1.0
Arsenic	—	0.05	Over 0.20
Cadmium	—	0–0.01	Over 0.05
Mercury	—	0–0.005	Over 0.01
Lead	—	0–0.05	Over 0.10
Nitrate as NO_3	33.8	0–10	Over 100

1. From: Swistock, B. 2016. Interpreting Drinking Water Tests for Dairy Cows. Pennsylvania State University.

2. Based primarily on criteria for good water for human use.

condition. This bloated appearance is especially apparent in young calves. Diarrhea caused by excessive water intake will still be normal in color and odor.

How to Measure Water Intake

Water intake should be measured only at the drinking device itself to accurately determine the water supply available to the animal. Water meters, which are available from many water system equipment dealers, can be used to measure water flow in lines leading to waterers. Data should be collected for 5–10 days to minimize effects of weather on water intake. Compute water intake from the ration (as moisture percent) and then calculate total daily water intake from drinking and from the ration. Finally, compute average daily water intake per pound of milk produced and compare with the typical 4.5–5 pounds of water needed per pound of milk produced. Useful conversion factors to remember include:

- One gallon of water weighs 8.34 pounds.
- One cubic foot of water weighs 62.4 pounds.

Problems with Water Quality

Water quality problems can occur with wells and springs, especially when associated with poor environmental management. Often, septic tanks, milkhouse wastes, and industrial drainage may be involved. Cows are particularly sensitive to poor water quality because high-producing cows may consume 200–300 pounds of water or more daily. Cows allowed to drink from surface water sources such as ponds and creeks are potentially at risk from bacteria and cropland runoff containing pesticides. Often, it is best to fence off these areas for better cattle health.

Chemical Quality. Hard water or antibacterial water treatment usually has no adverse effect on cows. High water levels of sulfate and magnesium may cause diarrhea and increase dietary requirements for selenium, vitamin E, and copper. Water with high iron levels may also increase the need for dietary copper, especially in lactating dairy cattle.

Water with pH less than 5.5 (acidic) may increase problems related to mild acidosis such as:

- reduced milk yield,
- depressed milk fat percentage,
- low daily gains,
- off-feed problems,
- more infectious and metabolic disease,
- increased infertility, and
- increased cow culling.

Alkaline water (pH greater than 8.5) may result in problems related to mild alkalosis such as amino acid and B-vitamin deficiencies, and symptoms similar to mild acidosis. When cows are drinking alkaline water, rations high in alfalfa, buffers, and minerals are more likely to contribute to mild alkalosis.

It is also important to consider the amount of minerals consumed in drinking water when balancing rations based on dietary cation-anion difference (DCAD) as the total intake of anions and cations may be influenced by the minerals contained in the water. In turn and if free water intake is accounted for, either anions or cations may influence DCAD. For example, many water supplies contain high concentrations of Na and Ca and lack countervailing anions. As a result, when consumed by cattle this water may be detrimental to transition cow programs. More prevalent though, are high anion waters, which will move lactating cows out of their optimal DCAD range

Nitrate (NO_3) levels over 100–150 parts per million (ppm) may cause reproductive problems in adult cattle. Replacement heifers will experience reduced growth rates. Generally, there is no significant effect of mildly elevated water nitrate levels on milk production. Nitrite levels in

water that are over 4 ppm may be toxic to cattle. Symptoms include infertility, reduced gains, abortions, respiratory distress, and eventually death.

Bacterial Quality. Water for animal consumption must contain no coliform bacteria for calves, and the coliform count should be under 10 per 100 milliliters for adult cattle. Bacterial polluted water may increase susceptibility or contribute to a variety of calf and cow disease problems. Drinking bowls, cups, and troughs (tanks) should be kept relatively clean. A raised base around tanks helps to keep manure contamination problems to a minimum. Cleaning tanks and water bowls to prevent buildup of old feed and other debris is important.

Checking Water Quality

The water supply for cattle should be checked yearly for coliforms, pH, nitrate and nitrites, and total bacteria—especially if a water quality problem is suspected. Many commercial laboratories offer water testing services. To obtain information about where water can be tested, contact your local extension office. Expected levels for common water quality tests are given in *Table III.*

Adequate Watering Facilities

There should be no more than 20 cows for each waterer in freestall or holding areas. Waterers, like feed bunks, should be convenient and readily accessible for the cattle. Lactating cows should be close to a water supply, especially during periods of heat stress or bitter cold and frozen surfaces. If possible, under these conditions try to place a clean supply of water near shaded or otherwise cooled loafing areas, and safe slopes if frozen. Take care to avoid excessive water accumulation in lots or other loafing areas, which may increase the incidence of mastitis and other diseases in the herd.

Summary

Although we are often most concerned with ration protein, energy levels, and dry matter intake, providing an adequate supply of fresh, clean water is one of the most essential feeding practices. You cannot expect maximum cow and calf performance unless the needs for water quality and intake are satisfied fully. If water quality problems are suspected, your veterinarian can recommend and interpret any tests that might be necessary.

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