Improving Water Quality For Dairy Cattle Production

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Introduction

Water is the most critical element of successful dairy cattle production. It accounts for 50 to 80% of an animal's weight gain and is involved in several physiological processes. Since milk is 87% water, dairy cattle consume more of it per unit animal weight than any other livestock. Lactating dairy cows are under more stress than non-lactating cows. In addition, hot weather, feed with low moisture content and disease can compound this situation. As a result, a reduction in dairy cattle performance should prompt producers to evaluate the quality of the water they are providing to their animals.

Water quality can affect dairy herd production by either reducing water consumption (due to reduced palatability) or from physiological stress (by gastric system upset or toxic effects). Both feed consumption and milk production are directly related to water consumption. Therefore, if poor water quality affects consumption, it will ultimately affect productivity.

Depending on the location of the livestock operation in Nova Scotia, different water quality challenges exist. It is useful to consult with a water quality specialist in your area to identify common water quality problems and recommend solutions. Conducting an environmental farm plan for your operation will also help to identify and resolve any water concerns. Proper management of the water source can help to avoid and solve many water quality problems.

At other times, more costly measures such as water treatment or mineral addition to your livestock's diet may be needed to compensate for reduced water quality.

Feed intake and water consumption are directly related

By understanding the characteristics of your water supply, you will be able to identify potential parameters that may influence cattle productivity, and then consider treatment options.

Improving the Dairy Farm Water Source

Management of the water source is the first step and usually the most cost-effective approach to improving farm water quality. Typical management includes selecting the best available water source, protecting the source, and enhancing it through aeration and shock chlorination.

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Selection of the best available water is achieved by locating the pond so that it captures the highest quality water. Gated inlets allow selection of desirable water and control the rate of inflow into the pond.

Fencing and exclusion of animals from the pond protects the water source. Trimming of trees and bushes within 50 m (160 ft) of the pond will reduce organic matter contamination from leaves and twigs.

Aeration can increase water consumption and weight gain in cattle. Aeration improves water palatability for humans and may do the same for cattle. Aeration can also reduce cyanobacteria and algae growth by preventing re-suspension of nutrient-laden particles from the bottom of a pond. Properly designed intakes, grassed waterways and fenced ponds are other ways to maintain the water quality in a farm pond. The factsheet ***Managing Water Quality in Your Farm Pond*** provides more information on how to improve surface water quality.

Protecting a well from contamination and minimizing biofouling will help to ensure the best possible water. To do this, locate your well away from potential contamination during the planning stage. Build up the area around the well with clay soil to limit infiltration of contaminants. Slope the soil away from the well to ensure potential contaminants flow away from the opening, and verify that the well cap is water-tight and vented. Monitor the bacteria level in the well seasonally and shock chlorinate if required. These practices will maintain your water's quality and also increase the longevity of the well.

Management of the farm pond is the most cost-effective way to protect and enhance water quality

Contaminants that may affect the productivity of dairy cows

Limited research has been conducted to evaluate the impacts of poor water quality on dairy cattle. However, guidelines exist for livestock in general and are considered conservative. A wide range of contaminants in water have been identified as having potential to impact dairy cattle productivity. To ensure that your farm water quality is acceptable, it is recommended that you perform water quality analysis on a seasonal basis and compare your results to water quality guidelines for livestock.

A useful web tool that provides national guidelines and comments on specific water analysis is available at:
http://www.agric.gov.ab.ca/app84/rwqit

When reviewing this analysis, it is important to know that some water quality parameters can impact animal productivity. The following water quality parameters are often identified as those having the greatest impact on cattle performance.

Water sampling, analysis and record keeping allows producers to identify changes in water quality

Salinity or total dissolved solids (TDS) are measures of the soluble constituents in water. The current guideline for TDS is 3000 mg/L (ppm). Research has shown that milk production is not affected during winter months by water with 4400 mg/L of TDS compared to water at 1300 mg/L.

However, during summer months, milk yield is reduced by cattle which consume the higher TDS water. The first symptom of health impacts from high TDS water is mild diarrhea.

Sulphate guidelines for livestock consumption are 1000 mg/L. Research has found that productivity in beef cattle is impacted when these animals consume water with sulphate concentrations exceeding 1800 mg/L. As dairy cattle consume more water than beef cattle, there may be noticeable effects at 1000 mg/L. Calves often develop scours at levels greater than 500 mg/L, but over time may adapt to these concentrations. Sulphate affects ruminants by the cumulative effects of being exposed to sulphur. Mild diarrhea is an early indicator, followed by trace mineral deficiencies, especially copper. Feed supplies may also contain significant amounts of sulphur, further adding to what is contained in the water. Alkalinity greater than 500 mg/L may also compound the diarrheal effects of sulphate.

Hydrogen sulphide produced from sulphates by anaerobic (low oxygen) conditions can reduce water intake when concentrations are as low as 0.1 mg/L. Aeration of livestock water will prevent hydrogen sulphide production and will also strip off existing hydrogen sulphide.

Nitrate and Nitrite guidelines for livestock consumption are 100 mg/L and 10 mg/L respectively (this is equivalent to 22 mg/L nitrate-N and 3 mg/L nitrite-N). Nitrate is converted into nitrite in the rumen. When absorbed, the nitrite reduces the oxygen-carrying capacity of the blood. Ruminants are efficient in converting nitrate to nitrite; therefore, they are more susceptible to nitrite poisoning than other animals. Ingestion of very high nitrate water can cause asphyxiation of the animal in three to five hours. At lower levels, nitrate poisoning can result in depressed weight gain and appetite, infertility problems and reduced milk production. High levels of nitrates rarely occur naturally. Feed may also contain nitrates, adding to levels already found in the water.

Iron – There currently is no Canadian livestock guideline for iron levels as concentrations existing in water systems are not considered of sufficient toxicity. It is often suggested that iron will not affect cattle. However, concentrations exceeding 0.3 mg/L are a concern for pipelines and cleaning equipment as iron can precipitate on surfaces. It has been suggested that concentrations from 2 to 10 mg/L of iron can reduce both water intake and milk yield. High levels of iron, manganese and molybdenum can also contribute to induced copper deficiency.

Arsenic is a carcinogen in humans but the effect on livestock is not well known. Recently, arsenic guidelines for livestock have been reduced with the current guideline for livestock at 0.025 mg/L. This guideline is very conservative as it assumes 80% of the arsenic will be provided by the feed and also includes an additional safety factor. Dairy producers should carefully evaluate the risk and cost prior to treatment of water for arsenic.

pH is the measure of acidity or alkalinity. Dairy cattle prefer water with a pH level between 6 and 9. Water with a pH level of less than 5 may cause acidosis, resulting in reduced milk production, depressed milk fat test and reduced feed intake. Water with a pH greater than 10 may cause alkalosis with similar symptoms.

Hardness is a measure of the scaling potential of the water and is related to the content of calcium and magnesium. A production benefit or increase in water intake by dairy cattle from water softening (i.e. replacing calcium and magnesium with sodium) has not been observed. Softening water will remove low levels of iron and reduce scaling potential, thereby improving cleaning potential of the water and maintaining scale-free pipelines. Hardness in the range of 60 to 80 mg/L as $CaCO_3$ is a good balance between providing water that is neither too aggressive nor having excess scaling effect. Hardness is also listed in terms of grains: 1 grain per gallon is equal to 17.1 mg/L.

Microbiological guidelines exist for *E.coli* (100 counts/100 mL) and Total Coliforms (1000 counts/100 mL). Values of bacteria greater than these guidelines are an indication of contamination and although they do not necessarily indicate the presence of pathogenic (disease causing) organisms, there is an associated risk.

Ruminants are quite resilient to the presence of fecal matter (*E.coli*). The presence of specific viruses, bacteria or parasites will have more of an impact than the quantity of bacteria, as these pathogens can quickly spread to the herd.

Water supply disinfection can help combat bacterial problems, but disinfected water can quickly become re-contaminated as it enters troughs. Research has shown that bacteria levels in troughs can increase daily by 500 to 800 *E.coli* /100 mL. Therefore, disinfection is not practical when troughs are prone to contamination. Although many producers are concerned about supplying chlorinated water to dairy cattle, research suggests that low levels of chlorine (0.5-1.0 mg/L) will not reduce water consumption.

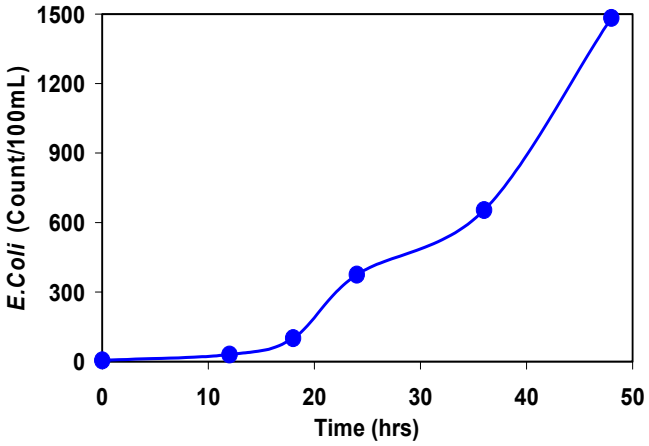

Figure 1: Watering trough E.coli counts over time

Cyanobacteria (Blue-green algae) blooms are common in nutrient-rich farm ponds. The challenge is to determine when the cyanobacteria will produce neuro- or hepato-toxins. The trigger for these toxins is not well known and producers are advised not to water livestock from ponds containing heavy growths of cyanobacteria. Critical concentrations of toxins can be avoided by minimizing the introduction of phosphorus and nitrogen into the pond. This can be achieved by reducing the amount of land-applied fertilizers and establishing grassed buffer zones around the pond. Drawing water from the centre of the pond, about 0.9 m (3 ft.) from the surface to avoid areas where cyanobacteria and toxins concentrate.

Water temperature can impact water consumption by cattle. Cattle typically prefer water between 10 and 30ºC. In most cases, the response by livestock to either chilling or warming the water does not justify the additional cost. Shading of water troughs will help to create a more stable water temperature.

Other toxic compounds in water can occasionally impact productivity in dairy cattle. The following table identifies these compounds and the associated guideline.

Cyanobacteria causes foul growth taste and odour and may produce toxins

Table 1: Other toxic compounds in water that may affect dairy cattle

Parameter	Guideline (mg/L)
Aluminum	5.0
Boron	5.0
Cadmium	0.08
Chromium	0.05
Cobalt	1.0
Copper	0.5 to 5.0
Fluoride	2.0
Lead	0.1
Mercury	0.003
Nickel	0.1
Pesticides	varies
Selenium	0.05
Vanadium	0.1
Zinc	50
Uranium	0.2

Water treatment may be justified for removal of some contaminants

Summary

Water is an important but often forgotten element of dairy cattle production. You can provide the best quality water by ensuring the proper management of the water source, which, in turn, will promote healthy weight gains and productivity in the livestock. Test water seasonally and compare the results to water quality guidelines. This will help to identify potential problems. Treatment of water is economically justified for some contaminants, but the producer must evaluate the cost-benefit of treatment.

The information in this factsheet is a summary from a literature review completed for the CNSWSEP project ***Improving Quality of Surface Water***. The full literature review and references included in the report can be found at http://www.nsfa-fane.ca/

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