Livestock and Water

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WATER INTAKE

Limitations on water intake depress animal performance more quickly and drastically than any other nutrient deficiency. Domesticated animals can live about 60 days without food but only seven days without water. Hearing and sight are impaired without water and humans have reported the incidence of headaches due to the lack of water.

Signs of Dehydration: Signs of dehydration or lack of water are tightening of the skin, loss of weight and drying of mucous membranes and eyes. One way to check for dehydration in the horse is by skin folds. Pull the skin and hold a moment. Release and count the seconds till the fold disappears. On a dehydrated horse, the skin will stand for several seconds.

Outbreaks of urinary calculi or water belly can be associated with weather conditions. Cold weather may reduce water intake, which reduces water flow through the bladder and kidneys. This reduced water flow allows kidney stones to precipitate. When desirable weather returns, water intake increases and urinary calculi problems are seen because the stones have become too big to pass through the male's urethra. Any factor that reduces water intake can be a contributing factor to urinary calculi. Hard water does not cause urinary calculi probelms but may be a factor if the hardness affects water palatability.

Temperature: Water should not be hot nor in the form of ice. Drinkable water is usually between 40 and 65 degrees F. Steers that have access to cool drinking water will gain .3 to .4 pounds more per day than those drinking warm water. Occasionally check waterers with heaters to detect a "runaway." Dip a thermometer into the water but do not allow it to rest on the bottom. Touching the heated bottom of the pan can result in higher temperature than actual water temperature. Check the temperature over several cold days. Water temperatures of at least 40 degrees F should minimize mechanical problems and maintain animal performance.

Adequate insulation can reduce problems with water freezing and reduce electric costs in North Dakota winters. Make sure the insulation inside the waterer is still in good condition. Conserve heat by caulking the base of the automatic waterer and seal the access door with weather proof tape. Reducing the wind on the waterer by a windbreak can also reduce electrical costs.

Extra external insulation may be added to some automatic waterers. Surrounded the external surface with 2 inches or more of styrofoam. Place ½-inch plywood over the styrofoam. Put galvanized steel on the top part of the styrofoam-plywood pieces and angle iron on the vertical edges. Wrap this external insulation with some 1/8 inch cable to keep it in place.

Stray electric current in a self heating troughs can reduce water consumption and thus reduce feed intake. Shut off the electricity to automatic waterers and check the inside for rodent nests. Make sure the connections are dry and there is a clean, tight ground.

Access: Cows given free access to water will produce more milk and more butterfat than cows allowed to drink only twice a day. The same animal will consume different levels of water at different physiological states. A pregnant or lactating animal will consume more than an open, dry animal. Horses that are hot from stenuous exercise should not have free access to water. They

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should be allowed only a few sips every three to five minutes until they cool down.

Nutrients in Diet: Increasing the salt concentration or the protein level of the diet stimulates increased water intake in all species because of the increase in urine volume necessary for the excretion of salt and urea. Studies with poultry have shown an increase in water consumption due to increases in fat, protein, salt or potassium in the diet. Feeds high in crude fiber such as roughages will require more water for ingestion than feeds low in crude fiber like barley and corn.

Stress: Reduced water consumption can be a sign of sickness or other stressors. Special considerations may be needed for valuable animals. Newly arrived animals may refuse water at first due to differences in palatability. Allow them to become accustomed to the new water supply by gradually mixing water from old and new sources. If this is not possible, then intake should be carefully watched to make sure there are no signs of dehydration. Mixing small amounts of molasses with home and foreign water sources can hide differences in taste. Have water available during low activity times during the day. Consumption of water and feed can be reduced when there is a lot of activity to divert animals' attention.

Composition of Water: Water quality, as well as quantity, may affect feed consumption and animal health, since low quality water will normally result in reduced water and feed consumption. Chemically pure water is not found in nature. Actually, deionized-distilled (pure) water is undesirable for livestock. Certain salts and gases in solution make water more palatable if not present in excess.

Substances which may reduce palatability of water include various saline salts. Salts may be toxic at high levels. Substances which are toxic without much affect on palatability include nitrates and fluorine, as well as salts of various heavy metals. Other materials which may affect palatability or toxicity include pathogenic microorganisms, hydrocarbons, oily substances pesticides and many industrial chemicals which sometimes pollute water supplies.

A hose should never be placed under the surface of the water in an animal watering tank or in a chemical sprayer tank. The tank might fill over the outlet of the hose, resulting in loss of water pressure and back siphoning when a hose or faucet is submerged. The entire water system may then become contaminated by impurities or poisonous solutions.

Cleanliness: All water troughs should be frequently cleaned. Livestock should never be forced to drink dirty or contaminated water. Stale water can cause reduced water consumption.

Dirty water is a host for disease organisms, and disease can spread rapidly if animals drink from the same trough. Sick animals should be isolated from the trough and the trough should be disinfected and cleaned. Sprinkling baking soda into the fountain periodically may reduce algae growth.

Have an elevated base around automatic waterers. Make the base wide enough so animals can easily put their front legs on it, but not their hind legs when they are drinking. Animals will not normally place only their hind legs on this base and therefore will not deficate in the water. Make the surface rough to they will not slip.

WATER QUALITY

If there is a question of water quality, it should be tested to obtain optimum production, especially in dairy, broiler, layer or swine operations. The following chemical properties should be considered when evaluating the quality of water for livestock:

Salinity: Salinity refers to salt dissolved in water. Salts commonly present include: carbonate, bicarbonates, sulfates, nitrates, chlorides, phosphates, anf fluorides. Highly mineralized waters (high solids) do not have much effect on health as long as there is no objectionable continuing laxative effect and as long as normal amounts of water are consumed. One gram of sulfate per liter may result in scours. Salts such as sodium chloride change the electrolyte balance and intracellular pressure in the body, producing a form of dehydration. Salts also place a strain on the kidneys. Excess fluoride causes degeneration of the teeth.

High salt concentrations that are less than toxic may actually cause an increase in water consumption. Animals may refuse to drink high saline water for many days, followed by a period where they drink a large amount. They may then become sick or die. The tolerance of animals to salts in water depends on factors such as water requirements, species, age, physiological condition, season of the year and salt content of the total diet as well as the water. Animals, however, have the ability to adapt to saline water quite well, but abrupt changes from waters of low salts to waters of high salt concentrations may cause harm while gradual changes do not.

Salinity is expressed as parts per million (ppm) or as milligrams per liter (mg/l). Both the state health laboratory (Bismarck) and the NDSU veterinary diagnostic laboratory (Fargo) conduct tests for salinity. The expression "total dissolved solids" (TDS) is often used to denote the level of water salinity.

The limiting figures given below are for a mineral content that makes the water either taste too bad to drink or if used for drinking can be expected to have a detrimental effect on health. It appears to make little difference whether the total quantity of dissolved salts or

TDS (ppm or mg/l)	Comments
Less than 3000	Usually satisfactory for most livestock
3000-5000	May not cause adverse effects to adult livestock. Growing/young livestock could be affectd by looseness or poor feed conversion. Near 5000 ppm the water is unacceptable for poultry
5000-7000	Should not be used for pregnant or lactating females. Usually laxative and may result in reduce water intake.
7000-10,000	Do not use for swine. Do not use for pregnant or lactating ruminants or horses.
10,000 or more	May cause brain damage or death.

Dissolved Solids (ppm)

Species	Excellent	Good	Fair	Poor	Limit
Humans	0-800	800-1600	1600-2500	2500-4000	5000
Horses-working	0-1000	1000-2000	2000-3000	3000-5000	6000
others	0-1000	1000-2000	2000-4000	4000-6000	10000
Cattle	0-1000	1000-2000	2000-4000	4000-6000	10000
Sheep & Poultry	0-1000	1000-3000	3000-6000	6000-10000	15000
Chickens	0-1000	1000-2000	2000-3000	3000-5000	6000
Swine	(young pigs and market pigs appear to tolerate less than cattle)				

dissolved solids is made up of a single salt or a number of salts. Conductivity values of more than 6,000 micro-ohms indicate high total dissolved solids.

Hardness is actually caused by calcium and magnesium. Softening the water through exchange of calcium and magnesium with sodium may cause problems if water is already high in salinity.

When there is a significant amount of calcium in water from a limestone source, it should be considered as a part of the total mineral intake. However, many mineral salts are relatively insoluble and pass through the body without being absorbed. Even in hard water, the amount of mineral ingested from the water is not likely to be substantial.

Animals can become acclimated to the sulfates in water. Consider diluting high sulfate water with low sulfate water for newly arrived animals. Use the same procedure for pigs at weaning time. The sulfate recommendation for calves is for less than 500 ppm (167 ppm sulfur as sulfate), and for adult cattle it is less than 1000 ppm (333 ppm sulfur as sulfate). Caution is required in evaluating sulfate levels in water because of interactions with copper and molybdenum and the inhibiting effect compounds such as sodium fluoride have on sulfate absorption for the digestive tract. These interactions and inhibitions make determining guidelines about sulfate removal from water difficult. Aquifers at different depths may be lower in sulfates.

Nitrates: Nitrate toxicity is seldom caused by water alone. It is usually a feed problem. The majority of nitrate poisoning cases in North Dakota involve drought stressed oats, corn and barley. High nitrate content interferes with the oxygen-absorbing power of the blood and in infants and gives rise to a "blue baby" condition that may prove fatal. Non-ruminants may convert small amounts of ingested nitrate to nitrite in their intestines, but the amount converted is not harmful. Cud-chewing animals at any age can be affected by nitrates in the same way as human infants. They are able, however, to tolerate much higher concentrations of nitrate, as long as the fodder is not unusually high in nitrates.

Shortage of breath is one symptom of nitrate toxicity. Blood will look brown instead of red. Frothing at the mouth, convulsions, blue muzzle and bluish tint around eyes can also indicate nitrate poisoning. More moderate levels of nitrate poisoning are thought to cause poor growth, infertility, abortions and vitamin A deficiencies.

Ranchers may suspect nitrates as a cause of poor reproductive performance in their livestock. Nitrates can cause levels of progesterone in recently bred animals that are low or inadequate to maintain a newly developed fetus. A sign of a nitrate problem is a larger than normal number of animals coming back into heat or an inordinate amount of open females at the end of the breeding season.

Sources of nitrates in ground water include nitrogen fertilizers, animal manure, crop residues, human wastes and industrial wastes. Nitrates may be found in a shallow ground water table. The nitrate concentration will be the greatest in the upper part of a shallow ground water table and wells which just penetrate into the table. Shallow wells may have higher levels than deeper wells since the shallow ground water tables are more easily polluted with leached nitrates.

Protect watersheds against erosion, manure or chemicals. Shallow wells with poor casing are susceptible to contamination. A cracked well casing may allow contaminated ground water into a deep aquifer. Chlorination of water does not destroy nitrates but can convert nitrites back to nitrates. It is questionable, however, if this procedure will solve a nitrite problem. Chlorine in the drinking water cannot prevent the change of nitrates to nitrites in the rumen of the cow or sheep or in the ceacum of the horse.

Laboratory confirmation of nitrate poisoning requires chemical analysis of feeds and water available to animal. Chemical analysis of rumen contents for nitrate is not reliable.

Treatment of nitrate poisoning involves intravenous administration of methylene blue. A 4 percent aqueous solution is administered at the rate of 2 mg methylene blue per pound of body weight. It may need to be repeated. Mineral oil given via a stomach tube will increase the elimination of nitrites from the digestive tract.

The following tables apply to the significance of nitrates in water. There are three different units to express levels of nitrates in forage and water: (1) nitrate nitrogen (N), (2) potassium nitrate (KNO_3) and (3) nitrate (NO_3). These units correlate with each other as follows:

1% N = 7.22 % KNO_3 = 4.43% NO_3
or 1% KNO_3 = 0.14% = 0.61% NO_3
or 1% NO_3 = 0.23% N = 1.63% KNO_3

Nitrate Content

KNO_3	N	NO_3	Interpretation
Forages:			
0-1%	0-.15%	0-0.65%	Considered safe
1-3%	0.15-0.45%	0.65-2%	Exercise caution. May need to dilute or limit feed forages.
Over 3%	Over .45%	Over 2%	Potentially toxic
Water:			
0-720 ppm	0-100 ppm	0-440 ppm	Considered safe
720-2100 ppm	100-300 ppm	440-1300 ppm	Exercise caution. Consider additive effect with nitrates in feed.
Over 2100 ppm	Over 300 ppm	Over 1300 ppm	Potentially toxic

pH: High saline water is not the same as alkaline water. The water pH denotes either alkalinity or acidity. A pH of 7 would be neutral; over 7 indicates alkalinity; below 7 designates acidity. Most North Dakota waters are mildly alkaline with a pH value between 7 and 8. Acid water (pH below 7) have not been found to occur in most of North Dakota; however, there are some reports in the western part of the state in proximity to lignite veins.

Various degrees of alkalinity have been reported in the state. High alkalinity may cause digestive upsets, laxative action, poor feed conversion, and reduced water and/or feed intake.

Microbiologic Properties: There are many microorganisms in our water supply. Most are quite harmless to water sources. There are, however, certain organisms where caution should be used.

Green scum that builds up in livestock drinking troughs and tanks is algae. It cannot grow without sunlight. Some blue-green algae are toxic. No good method exists to predict whether or not the algaes will produce the toxins. All that can be done is to monitor livestock behavior when algae blooms heavily. Copper sulfate or other commercial copper-containing products often called bluestone will kill the algae for a period of several months. In troughs or small tanks, a safe dosage is one level teaspoon of copper sulfate per 1500 gallons of water. One ounce will treat 8,000 gallons of water. One pound per acre-foot is a good estimate for larger bodies of water. Generally, treatment is done only when algae growth is heavy or if a toxicity problem occurs. Hold livestock off the treated water source for at least 24 hours.

In treating large stock tanks or ponds, drag a sack containing the correct amount of copper sulfate behind a boat, pacing yourself to cover the heavily infested areas first. If the tank contains catfish (not scaled fish), treat half of the pond at a time and allow the fish to move to untreated water. Occasionally putting baking soda in water troughs will help prevent algae growth. Proper cleaning of automatic waterers can be quite effective in preventing algae growth. Consider the use of a disinfectant with poultry waterers.

Amount of $CuSO_4$ used	Water Volume for 1 ppm	Water Volume for ½ ppm
1 oz	7,800 gal	15,000 gal
8 oz	62,500 gal	125,000 gal
1 lb	125,000 gal	250,000 gal
8 lb	1,000,000 gal	2,000,000 gal

Coliform counts below 50 per milliliter of water are safe for all cattle. Other possible contaminants include: coccidia, staphs, streps, virus, lepto, etc.

Microorganisms can enter a well having improper surface protection. A well is situated improperly if the drainage from livestock pens, a manure pit or cracked well casing allows bacteria to enter the water supply. Cracks in cisterns can also allow access to microorganisms. Contamination might occur from a heavy, spring rainfall. Protect the surface of wells from contamination by rodents.

Signs of blue green algae poisoning are diarrhea, lack of coordination, labored breathing and death. During recovery unpigmented skin may slough off. A suggested treatment for algae afflicted animals is large quantities of medical-grade charcoal and mineral oil.

Other Chemicals: Many other chemicals may be found in water, some of which could be detrimental to livestock production. No accurate measurements of safe levels of herbicides and pesticides in water for animals have been determined. The following guidelines for humans appear to be reasonable for livestock.

Pesticide	Maximum Concentration mg/l
Aldrin	0.001
DDT	0.05
Dieldrin	0.001
Chlordane	0.003
Endrin	0.0002
Hephtachlor epoxide	0.0001
Hephtachlor	0.0001
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-T	0.01

Pesticides can enter a ground water or surface water supply from run-off, drift, and accidental spills. Provide adequate drainage around the water supply. Wells should be located on elevated ground to prevent surface run-off in to the well. Fish are much more sensitive to pesticides than other livestock.

The following are generally considered safe levels of some potentially toxic nutrients and contaminants in water for cattle:

Element	ppm
Aluminum	5.0
Arsenic	0.2
Boron	5.0
Cadmium	0.05
Chromium	1.0
Cobalt	1.0
Copper	0.5
Fluorine	2.0
Lead	0.1
Mercury	0.01
Nickel	1.0
Nitrate-Nitrogen	100.0
Nitrite-Nitrogen	10.0
Selenium	0.05
Sulfate	1000.0
Vanadium	0.1
Zinc	25.0

These are analyzed only when there is a good reason to suspect their presence at excessive levels.

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