Water Quality for Livestock

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Water is an essential nutrient for humans and livestock and drinking water is the primary source of water for most cattle. The most important aspect of water as a nutrient is generally the quantity consumed. Depression of water consumption due to contaminants is more common than an imposed mineral imbalance. Some salts and other elements when found in water at higher levels may reduce animal growth and production or may cause illness and death. However due to their physiological adaptability many animals are able to ingest a wide variety of different types of water and survive. The measures used to evaluate water quality include salinity, hardness, pH, sulfate, nitrate, and analysis for other specific elements known to be toxic.

Salinity refers to salts dissolved in water. The anions (negatively charged ions) commonly present include: carbonate, bicarbonate, sulfate, nitrate, chloride, phosphate and fluoride. The cations (positively charged ions) include calcium, magnesium, sodium, and potassium. Salinity is usually measured as total dissolved solids (TDS) or total soluble salts (TSS) and is expressed as parts per million (ppm) which is equivalent to mg/l or ug/ml. Total dissolved solids content of water is a valuable tool in detecting elemental excesses that may impose depressed consumption or mineral imbalances. An abrupt change from water of low salinity to water of high salinity may cause an animal harm while a gradual change will not. Animals can consume water of high salinity for a few days without harm, if they are then given water of low salinity. Animal tolerance also varies with species, age, water requirement, season of year and physiological condition. The ions of Magnesium (Mg) Calcium (Ca), Sodium (Na) and Chloride (Cl) all contribute to the salinity of water and they may cause toxic effects because of the salinity effects or interference with other elements. Highly saline water by itself is not likely to be a problem for cattle; however certain ions in saline water can be extremely detrimental to animal performance and can in some cases be fatal. Table 1 gives guidelines on potential uses of water with varying salinity. As the TDS for water increases, water intake also increases except at very high salt content where the animal refuses to drink. Table 2 provides information regarding water salinity and water quality.

Often water salinity is confused with water hardness. Hardness refers primarily to the calcium and magnesium content of water. Water containing appreciable amounts of calcium and magnesium are called “hard” because it is hard to make such water lather with soap. Water hardness is not necessarily correlated with salinity. It is possible for highly saline water to contain low concentrations of calcium and magnesium. Hard water was once considered as a potential cause of urinary calculi. This theory has since been discredited. Water hardness does not have a dramatic impact on the health or performance of cattle.

The most common component of salinity is the sulfate ion. Sulfate imparts a bitter taste to water but animals can acclimate to it. High sulfate levels in water have been associated with diarrhea, as a substrate for hydrogen sulfide production and as a dietary antagonist to copper. Hydrogen sulfide is a neurotoxic compound that can be fatal to cattle. Water containing as little as 1500 mg sulfate per liter has been shown to

reducer the copper status of cattle. For beef cattle the maximum recommended sulfate level for calves is 500 ppm and for adult cattle 1,000 ppm.

Nitrate toxicity is seldom caused by a water source alone but water high in nitrates may contribute to a problem involving high nitrates in a feed source. Dangerous nitrate concentrations in drinking water are often a result of runoff from heavily fertilized fields or from poorly cased shallow wells. The nitrate ion (NO_3) itself is not very toxic; however the nitrite (NO_2) is readily absorbed and is quite toxic, 10 times more toxic than nitrate. The bacteria in the digestive tract of ruminants and herbivores can readily convert nitrate to nitrite and then to ammonia nitrogen. When this conversion process is overwhelmed, nitrate poisoning results. The clinical signs of nitrate poisoning in animals include, lack of coordination, labored breathing, blue discoloration of mucous membranes, vomiting and abortions. Dairy cows can have reduced milk production without clinical signs.

The pH is a measure of acidity and alkalinity. A pH of 7 is neutral; less than 7 is considered acidic and over 7 alkaline. The preferred pH for livestock water other than that for dairy cattle is 5.5 to 8.3. The preferred water pH for dairy cattle is 6.0 to 8.0. Highly alkaline water can cause digestive upsets, diarrhea, poor feed conversion, and reduce feed/water intake.

Water although not considered a nutrient per se, is an essential element for livestock production. Water is required for the regulation of body temperature, as well as for growth, reproduction, lactation, digestion, metabolism, excretion, hydrolysis of nutrients, transport of nutrients and waste, joint lubrication plus many other functions. Water quality and quantity concerns are becoming more important across the United States. Because water is essential for livestock, having a working knowledge of water quality issues is important for livestock producers.

Table 1. TDS and species variation.

Total Dissolved Solids (ppm)					
Species	**Excellent**	**Good**	**Fair**	**Poor**	**Limit**
Humans	0-800	800-1,600	1600-2,500	2,500-4,000	5,000
Horses- working	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
Horses – other	0-1000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Cattle	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Sheep	0-1,000	1,000-3,000	3,000'6,000	6,000-10,000	15,000
Chickens and Poultry	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000

Boyles et al. 1988

Table 2. A guide to the use of saline waters for livestock and poultry.

Total Soluble Salts content of waters mg/l or ppm	Comment
Less than 1,000	These waters have a relatively low level of salinity and should present no serious burden to any livestock or poultry.
1,000-2,999	These waters should be satisfactory for all classes of livestock and poultry. They may cause temporary and mild diarrhea in livestock not accustomed to them, or watery droppings in poultry but should not affect their health and performance
3,000-4,999	These waters should be satisfactory for livestock, although they may cause temporary diarrhea or be refused at first by animals not accustomed to them. They are poor waters for poultry, often causing watery feces and increased mortality and decreased growth.
5,000-6,999	These waters can be used with reasonable safety for dairy and beef cattle, sheep swine and horses. Avoid the use of those approaching the higher levels for pregnant animals. They are not acceptable waters for poultry, almost always causing some type of problem, especially near the upper limit, where reduced growth and production or increased mortality will probably occur.
7,000-10,000	These waters are unfit for poultry and probably swine. Considerable risk may exist in using them for pregnant or lactating cows, horses, sheep the young of these species or for any animals subjected to heavy heat stress or water loss. In general, their use should be avoided, although older ruminant's horses or even poultry and swine may subsist on them for long periods of time under conditions of low stress.
More thatn 10,000	The risk with these highly saline waters is so great that they cannot be recommended for use under any conditions.
Source National Academy of sciences 1974	

References

1. Boyles, S. et al. 1988 Livestock and water. North Dakota State University, Extension Service Bulleting # AS-954
2. National Academy of Sciences, Nutrients and toxic substances in water for livestock and poultry.