AN195

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Water Nutrition and Quality Considerations for Cattle[1]

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Introduction

Safe supplies of water are essential for optimal production of any livestock species. As water resources become increasingly competitive, the supply of quality water for cattle will continue to come under greater pressure from other sources. The close proximity of Florida's water table to the soil surface and the potential for salt water intrusion warrant attention to the amount and quality of water available for cattle consumption.

Water is the most common molecule in the body (98% of all molecules) and is involved in nearly every function in the body, it is that important. Water is a requirement for vast number of functions in the body: the regulation of body temperature, physiological processes including growth, reproduction, lactation, digestion, metabolism, joint function, eyesight, and mineral balance. Water is the main transport medium for glucose, amino acids, mineral ions, water-soluble vitamins, and transport of waste (NRC, 1996).

Water sources for cattle should be periodically sampled for quality and potential contaminants. Water sources for livestock should also be analyzed whenever a significant change in well levels, water source, or potential contamination occurs.

Water Intake

The largest influences on water intake by cattle are dry matter intake, ambient temperature, humidity, and physiological stage of production. Water intake comes from two sources, that consumed free choice from water sources and water that occurs in feedstuffs consumed by the animal. The water content of feeds will vary widely; feeds such as lush pasture and silage are likely greater in water content, whereas hay, grain, and dormant forage can be quite low in moisture. The minimum water intake for cattle relates to the need for body growth, fetal growth, lactation, activity or physical exertion, and that lost by excretion in urine, feces, sweat, and by evaporation from the lungs and skin.

Water intake for cattle can be estimated by the equation developed by Hicks et al. (1998):

Water intake (gallons/day) = 4.939 + (0.1040 x MT) + (0.2923 x DMI) – (2.597 x PP) – (1.1739 x DS)

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Where:

MT = weekly maximum temperature in °F

DMI = dry matter intake in lbs of feed/day

PP = weekly mean precipitation in inches

DS = percent of dietary salt in %.

Water Quality

Water quality is an important consideration to achieve optimal water intake and acceptable cattle performance. Criteria for evaluating the acceptability of water for livestock include a number of factors listed in Table 1.

The importance of water quality cannot be overstated. While the amount of water intake is determined by a number of previously identified factors, water quality will dictate if cattle will consume the water. Likewise, water quality will indicate the relative level of safety repitition of the water to cattle. Below is a brief discussion of a number of the quality factors that affect safety and acceptability of water for cattle.

pH

Water pH is a measure of the acidity or alkalinity. Water below pH 7 is considered acidic, whereas above pH is considered alkaline. Cattle will tolerate water of pH 6.5 to 8.0. The pH of water can influence taste, corrosive potential, efficiency of chlorination, and numerous other properties.

Salinity (Total Dissolved Solids)

For fresh water, salinity and total dissolved solids (TDS) are equivalent. Salinity/TDS is the amount of dissolved salts in the water. The salinity/TDS measures primarily sodium chloride, but can include carbonates, nitrates, sulfates, calcium, magnesium and potassium. Hard water, per se, is not detrimental to livestock unless the water has a high level of salinity. Table 2 indicates the guidelines for consumed water salinity.

Nitrates and Nitrites

The performance and reproduction of cattle can be affected by nitrates in water. While nitrates (NO_3) are not toxic, when the nitrate is converted to nitrite (NO_2) toxicity occurs. Nitrates enter the rumen and are converted to nitrites which then enter the bloodstream. Nitrites affect the red blood cells' ability to transport oxygen. Death occurs from suffocation due to lack of oxygen. Nitrate toxicity from water most likely occurs when livestock drink from ponds or ditches that have been contaminated with run-off from heavily fertilized fields, manure piles, or dead animals. Table 3 is a guide to the concentrations of nitrate and nitrate nitrogen in water.

Contaminants and Toxic Elements

Water from certain sources may contain toxic levels of some minerals. Contamination can originate from numerous sources including mining slag, old dipping vats, improper disposal of batteries, or other sources of metals. Table 4 lists several mineral contaminants and their upper recommended limits.

Water is a vital part of the nutrient intakes of cattle. Both quantity and quality of water is important to achieve optimal performance of cattle. Consuming water is more important that consuming feed because of water's vital importance to the animal's physiological functions. The Florida climate necessitates the availability of quality water sources for cattle on a continual basis. Regardless of the source of water, producers should ensure that the water is protected from contamination by chemicals, excess nutrients, and harmful biological organisms.

References

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Table 1. Considerations for livestock water quality.[a]

Physio-chemical	Toxic compounds	Biological	Organoleptic
pH	Arsenic	Total bacterial count	Odor
Salinity (TDS)[b]	Cyanide	Coliform presence	Taste
Nitrates / Nitrites	Lead	Blue-green algae	Turbidity
Sulfates / Chlorides	Mercury		
Iron	Hydrocarbons		
Sodium	Organochlorides		
Fluorine	Organophosphates		

[a]Adapted from Harris and Van Horn (1992).
[b]TDS = Total Dissolved Solids.

Table 2. Guide to the use of saline water for livestock.[a]

Total Dissolved Salts (mg/L or ppm)	Comment
Less than 1,000	Presents no serious burden to livestock
1,000 – 2,999	Slightly saline. Should be satisfactory. May cause temporary and mild diarrhea to unaccustomed livestock, but should not affect health or performance.
3,000 – 4,999	Moderately saline. Generally satisfactory. May cause temporary diarrhea or be initially refused by unaccustomed livestock.
5,000 – 6, 999	Very saline. Reasonable safety for adult livestock. Avoid consumption by high producing, pregnant, lactating, or young livestock.
7,000 – 10,000	Approaching brine. Avoid if possible. Considerable risk for pregnant, lactating, stressed, or young livestock.
Greater than 10,000	Brine. Unsafe. Do not use under any conditions.

[a]Adapted from *Nutrients and Toxic Substances in Water for LIvestock and Poultry (1974).*

Table 3. Levels of nitrate in water and expected response.[a]

Nitrate in Water (ppm)		
NO_3	NO_3-N	Comment
0 – 44	0 – 10	Not harmful to livestock.
45 – 132	10 – 19	Safe, if diet is low in nitrates and nutritionally balanced.
133 – 220	20 – 39	Could be harmful if consumed over long periods of time.
220 – 660	40 – 99	Cattle at risk. Potential death losses.
660 – 800	100 – 199	Unsafe. High potential for death losses.
Over 800	Over 200	Unsafe. Do not use.

[a]Adapted from *Nutrients and Toxic Substances in Water for LIvestock and Poultry (1974).*

Table 4. Recommended limits of concentration of potentially toxic substances in livestock drinking water.[a]

Item	Upper Limit, mg/L or ppm	Item	Upper Limit, mg/L or ppm
Aluminum	5.00	Lead	0.10
Arsenic	0.20	Mercury	0.01
Cadmium	0.05	Molybdenum	0.50
Chromium	1.00	Nitrate-N	100.00
Cobalt	1.00	Nitrite-N	10.00
Copper	0.50	Selenium	0.05
Fluoride	2.00	Zinc	25.00

[a]Adapted from *Nutrients and Toxic Substances in Water for LIvestock and Poultry (1974).*