

ACCEPTABLE MINERALS IN FARM WATER

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Adequate supply of clean palatable water is a prime prerequisite for best results in animal production. Deficient intake of water results in lowered appetite and loss of efficiency in feed conversion. Mineral content affects the palatability of clean water.

Water free from traces of dissolved minerals does not occur anywhere in nature. Rain water contains trace amounts of the gases present in the atmosphere plus varied amounts of other gases occasionally present, such as ammonia and the oxides of sulfur and nitrogen. Trace amounts of mineral salts absorbed from dust particles floating in the air also are present.

Pond water and other surface water usually contain 200 to 500 ppm of dissolved minerals, while ocean water contains around 35,000 ppm. Underground water may contain from 200 up to 350,000 ppm of dissolved minerals.

Effects of Dissolved Mineral Salts

Water begins to decrease in palatability when the amount of minerals exceeds 500 to 1000 ppm, depending on the nature of the minerals. Beyond these limits the water becomes increasingly unpalatable and finally toxic.

Man nor farm animals will voluntarily drink a highly mineralized water when better water is available. When forced to drink it, they may develop a tolerance to its taste and its physiological effects. The time required to develop this tolerance ranges from a few days to several weeks or months, depending on the species, age and condition of the animal and on the nature and amounts of the minerals. There is a limit to the amount of minerals that can be tolerated beyond which both water and feed intake is depressed. In such cases,

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rapid loss in body weight, clinical signs of toxicity and finally death occurs.

The bicarbonates of sodium and the chlorides and sulfates of sodium and calcium are better tolerated than the corresponding potassium and magnesium salt. Waters containing carbonates of sodium and potassium are decidedly alkaline in reaction, and the limits of tolerance are only half that of their chlorides and sulphates. Limited experimental work indicates that there are little species differences in water tolerance when the moisture content of the rations is similar.

Practical experience and a limited amount of controlled experimental work indicate that chickens, swine, cattle and sheep can survive and remain in good health on saline waters containing up to 15,000 ppm of minerals such as the bicarbonates, chlorides and sulphates of sodium and calcium, and up to 10,000 ppm for the corresponding salts of potassium and magnesium. The limits of tolerance to alkaline waters, those containing sodium and calcium carbonates, are around 5,000 ppm.

During the period of adjustment to highly mineralized waters, the feed and water intakes, rates of growth, rates of lay and milk yields are depressed. However, feeding tests with rats, chickens and swine at the Oklahoma station indicate that these species, after they become adjusted to the water, can maintain normal feed efficiencies up to limits of mineralization consistent with the maintenance of health.

Toxic Minerals

Of the surface and underground water minerals, lead, arsenic, selenium, chromium (hexavalent forms) and fluorine are cumulative poisons. When present in drinking water in excess of the mandatory limits, Table 1, they are not eliminated from the body fast enough to prevent the buildup of toxic levels in the liver, bones and other parts

of the body. Water containing these minerals in excess of mandatory limits are unfit for animal consumption except for brief periods.

Table 1. Mineral Tolerances For Human Drinking Water*

	Mandatory upper limits, ppm
Lead	0.05
Arsenic	0.05
Selenium	0.01
Chromium (hexavalent)	0.05
Fluorine	1.5
Barium	1.0
Cadmium	0.01
Cyanide	0.2
Silver	0.05
	Non-mandatory upper limits, ppm
Zinc	5.0
Iron	0.3
Manganese	0.05
Copper	1.0
Magnesium	1.25
Boron	1.0
	Non-mandatory upper limits, ppm
Chlorides	250
Sulfates	250
Total solids (desirable)	500
Total solids (permissible)	1000

These limits are based on considerations other than toxicity such as lack of palatability and excessive hardness.

*Standards established by the U. S. Public Health Service for drinking water carried on passenger trains and other interstate carriers. (U. S. Public Health Reports 40:693, 1925 and later amendments.)

In the case of highly mineralized waters, it is important to know the mineral content of both the water and the feed, relative to the total mineral intakes and mineral ratios.

All of the nutritionally essential minerals occurring in feeds and water, including sodium, potassium, calcium, magnesium, iron, manganese, copper, zinc, molybdenum, cobalt, iodine, selenium and chromium (hexavalent forms), are toxic at sufficiently high levels. *They are safe only within limited quantitative ranges.* All are potentially harmful.

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