Nebraska Department of Health and Human Services

Nitrates and Coliform Bacteria in Water Supplies

Is your water safe? Nearly 20% of Nebraska's population depends on private wells for its water needs. Routine sampling has shown that 15% of water supplies are contaminated with coliform bacteria, have elevated nitrates levels, or both.

Bacteriological and/or nitrates contamination can have serious health consequences. These can be avoided by regularly and routinely testing private water supplies. Such testing should be a priority for all private well owners. It is recommended that private wells be tested for total coliform and nitrates on an annual basis. This page will tell you the sources and health risks associated with bacteria and nitrates in water supplies, how to get a water sample analyzed, and what the results of the analysis mean.

Sources and health risks of nitrates in water

Nitrates are a nitrogen/oxygen compound that naturally occurs in low concentrations in ground water. Under normal circumstances, only a very small percentage of the total nitrates consumed by adults comes from drinking water. The vast majority of nitrates in the diet normally comes from cured meats and vegetables such as spinach, lettuce, beets, and carrots. The recommended limit for nitrates-nitrogen (the amount of nitrogen in nitrates form) in drinking water is 10 milligrams per liter.

Sources of nitrates

Nitrates are derived from nitrogen -- an element which occurs naturally in many different forms in the environment. When nitrogen enters the soil, it is converted to nitrates by microorganisms. Plants use some of these nitrates; any excess is carried down through the soil into the groundwater in a process known as "leaching."

At times, far more nitrogen enters the soil than plants can use, leading to dangerously high levels in ground water. There are several ways this can occur.

- Animal and human waste contains nitrogen in the form of ammonia;
- A concentrated source of waste (for instance, a feedlot or a leaking septic system) can lead to a high nitrates level in water.
- Runoff from agricultural lands can also cause elevated nitrate levels, because fertilizer contains a lot of nitrogen.
- Decomposing plant and animal material can also generate nitrates.

Not surprisingly, most cases of nitrates contamination occur in agricultural areas. In fact, concentrations of 30 milligrams a liter or higher can occur in some cases.

Health risks from nitrates

High nitrate levels are a cause of concern for several reasons. They are often associated with methemoglobinemia, commonly known as 'blue baby syndrome."

Methemoglobinemia

In infants under six months of age, nitrate levels higher than 10 milligrams per liter can have toxic effects. This occurs because of the reduction of nitrates (NO_3) to nitrite (NO_2) in the infant's stomach. Nitrite enters the bloodstream and binds to hemoglobin, changing it to methemoglobin. This interferes with the blood's ability to carry oxygen to the body tissues. An infant afflicted with *methemoglobinemia* will literally

turn a bluish color -- because his tissues are starving for oxygen. It is literally a form of slow suffocation. Vomiting, diarrhea and labored breathing are other symptoms of the disease.

Methemoglobinemia is uncommon and rarely fatal, but if an infant shows signs of the condition, medical help should be sought immediately. An alternate source of water should be found for infants under six months of age if the main water supply contains more than 10 milligrams of nitrate-nitrogen per liter. Older children and adults are able to withstand much higher levels of nitrates with no risk of *methemoglobinemia*, because their stronger stomach acid content kills the bacteria.

There is also a potential for prenatal *methemoglobinemia* or birth defects associated with high nitrate levels. Pregnant women should avoid drinking water with nitrate-nitrogen levels higher than 10 milligrams per liter.

Cancer risk from nitrates
There have been some indications of a potential link between high nitrates in drinking water and gastrointestinal cancer. Nitrites could potentially combine with amines in the body to form N-nitroso compounds -- known cancer-causing agents. However, this association is controversial.

There have been reports of abnormally high levels of gastric cancer in areas with high nitrate levels in the drinking water. As yet, however, there is no conclusive proof of a link between the two. Considering the questions surrounding the issue, it does seem prudent to view nitrate levels higher than 10 milligrams/liter as a possible cancer risk factor.

Livestock are also susceptible to nitrate poisoning, especially cattle. Lowered milk production and aborted calves are two signs of the disease. In general, through, livestock can withstand much higher nitrate levels than humans.

Sources and health risks of coliform bacteria in water
Coliform bacteria are microscopic, generally harmless organisms that live in the environment as well as the intestinal tract of many warm-blooded animals. Coliform bacteria are not directly disease-causing, but they are often found with other, more dangerous strains of bacteria. People with severely compromised immune systems, infants and some elderly may be at increased risk.

Water sampling
Water sampling can be performed for a fee by the Public Health Environmental Laboratory, 3701 S. 14th Street, P.O. Box 22790, Lincoln, NE 68502, (402) 471-3935, or other state-approved laboratories (a list is available from the Public Health Environmental Laboratory).

Water sample bottles are available from the Public Health Environmental Lab and many local health departments and county extension agents. Instructions are included with each container. Separate sample bottles are required for nitrates and coliform tests. The nitrates sample bottle contains an acid preservative to hold nitrate-nitrogen and must be used within 30 days.

Procedures
Water sample bottles should not be rinsed out before use. Water samples shouldn't be collected from outside hydrants, leaky faucets, or faucets with aerators. Filters still attached should be removed, since these may produce false-positive results when the water supply is actually safe.

Water treatment systems can also give unpredictable results; the sample should be taken from a tap that isn't connected to the treatment system.

"Flaming" of water taps (sterilizing them with a Propane torch) is not essential but should be performed when practical, especially after the removal of an aerator or filter.

Water should be run for five minutes before the sample is taken. Water shouldn't be allowed to splash the neck or cap of the bottle.

Results

For nitrates:
Water with a nitrate-nitrogen level higher than 10 milligrams per liter is cause for concern, especially if infants under six months of age, pregnant women, or nursing mothers will be drinking it. In those cases, a safe alternate supply of water should be found. Boiling will not reduce the nitrate levels in drinking water. In fact, boiling will actually increase nitrate concentrations, because the nitrates won't evaporate with the water.

If the only people using the water will be adults and older children, a nitrate-nitrogen level over 10 milligrams/liter is less critical. You may want to consult with your family physician or another health professional before deciding on a course of action

Bottled water from a reputable company is an acceptable temporary water supply. A national list of bottled water suppliers is available from most local health departments.

For coliform bacteria:
Bacterial contamination cannot be detected by sight, smell or taste. The only way to know if a water supply contains bacteria is to have it tested.

If the results of the bacteriological test come back as “satisfactory,” the water was absent of coliform bacteria and meets the drinking water standards.

If the results of the test indicate that the sample "does not meet the bacteriological standards," it means that total coliform bacteria are present. Coliform bacteria are generally not harmful themselves. Coliforms are bacteria which are naturally present in the environment and are used as an indicator that other potentially harmful bacteria may be present.

Do not drink the water if *E. coli* bacteria are present. For drinking and food preparation, bring water to a rolling boil for one minute, use another source of water, or use bottled water. Continue this until your water supply can be disinfected or is retested and proven to meet drinking water standards.

Treatment

For nitrates:
There are several possible ways of dealing with nitrates contamination of your water supply. The most common solution is simply drilling a new well away from any possible sources of contamination.

Modern well drilling and installation methods will usually reduce nitrate levels, but results are not guaranteed. If constructing a new well is unfeasible, there are several methods for removing nitrates from an existing water supply, including distillation, reverse osmosis, and ion exchange. All of these methods involve expensive treatment systems which require periodic maintenance to be effective. The Office of Drinking Water and Environmental Health can advise you on the best approach for your situation.

For coliform bacteria:
Treatment of coliform bacteria is relatively simple and inexpensive. Instructions on how to perform the procedure (known as "shock chlorination") are available from the Office of Drinking Water and Environmental Health.

Follow-up Procedures
Water quality depends on a whole host of factors, such as:

- proper well construction and location,
- the groundwater level
- soil formation, and
- other geological and mechanical factors.

A single test for either nitrates or coliform bacteria is not enough to guarantee that a well is safe to drink from. A heavy rainfall, a failed sewage system, a chemical spill, or many other similar events may render

a water supply unsafe in a very short period of time. A water analysis should be performed whenever repairs or alterations are made to the water supply system, or if contamination of the well is suspected.

Also, be aware that nitrates and coliform contamination are often found together, since they can both come from the same source (a sewage leak or runoff from a feedlot, for example). Therefore, if one type of contamination is detected, you may want to test for the other.

Recurrent problems with coliform or nitrates contamination may indicate a problem with your well location or construction. Contact the Office of Drinking Water and Environmental Health or a licensed well contractor for advice.

For more information on well contamination or other water quality issues, please contact:

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