

Nitrogen in the Environment: Nitrate Poisoning

Reviewed by David Brune
Department of Agricultural Engineering

Scott C. Killpack and Daryl Buchholz
Department of Agronomy

Nitrate (NO_3^-) is a naturally occurring form of nitrogen found in soils. Nitrates result from the biological decay of plants, animals and organic matter. Nitrates in the soil can also result from nitrogen fertilizers and animal manure. Some nitrates in the soil come from the atmosphere through rain or snow. Nitrates are essential to plants for proper growth and development.

Nitrates are not held by soil particles and are easily moved by water. If soil and/or bedrock conditions allow, nitrates can be moved into groundwater. As a result, nitrates can sometimes be found in water at concentrations that can pose serious problems.

How does nitrate poisoning happen?

The greatest danger is for babies less than one year old. Small babies have a bacteria in their digestive tract that converts nitrate into nitrite, which is toxic. Nitrite reacts with a substance in the blood called hemoglobin. Hemoglobin is part of the red blood cell that transports oxygen to all parts of the body. When nitrites are present, hemoglobin will preferentially combine with nitrite instead of oxygen. The new substance formed is called methemoglobin and does not carry oxygen. As the amount of methemoglobin increases, the amount of oxygen in the blood decreases, eventually causing internal suffocation.

The most common symptom of nitrate poisoning is a bluish color to the skin, particularly around the eyes and mouth. The blood will also turn a chocolate-brown color, which reflects the lack of oxygen.

After six months to one year, the digestive system no longer contains the nitrate-converting bacteria. In older children and adults, nitrate is not changed to the toxic nitrite. It is absorbed and excreted by the body.

People are also exposed to nitrates in their diets. The average dietary intake of nitrate is 75 to 100 milligrams per day. Nitrate is mainly taken in through vegetables because it is a natural substance found in plants. Some common vegetables with high nitrate content include beets, celery, lettuce and spinach.

Nitrate water standards

Nitrates become a concern when they exceed the maximum safe standards established by public health agencies for safe drinking water by humans. The maximum standard for nitrate, when it is reported as **nitrate-nitrogen**, represents the proportion of nitrogen in the nitrate molecule and is set at 10 ppm. These two values are equivalent. They do not reflect more, or less, nitrate in water, but simply a difference in how nitrate is reported. Therefore, when interpreting a water analysis for nitrate, you must determine how the nitrate concentration is being reported so that the correct health standard can be applied.

Table 1

Maximum safe levels for nitrate in drinking water

Reported as	Maximum value in parts per million ¹
Nitrate-Nitrogen	10
Nitrate	45

¹Example

One ppm of sugar in water would be equivalent to one ounce of sugar in 7,813 gallons of water.

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