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Nitrate and Health

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Nitrate is a complex issue in biology and in politics. It is very difficult to tell farmers to use less fertilizer - their livelihood depends on crop yield, and plants need nitrogen. This complicates the politics: it's difficult to set policies that may result in higher food prices. The political aspects help to explain why there has been so little research or examination of existing data to see whether there are pools of particular health problems wherever there is too much nitrate in the drinking water. Much of the research on nitrate and health issues has been done in countries outside the US.

On the biology side is the fact that all living things are made of proteins - which are in turn made up of amino acids - and nucleic acids (DNA and RNA). Proteins and DNA contain nitrogen. Some plants can use nitrogen gas directly from the air - this is called nitrogen fixation. All plants can take up simple nitrogen-containing compounds through their roots - examples are urea, ammonia, and nitrate. Plants are then able to fabricate amino acids, proteins, and DNA from these simple chemicals.

Animals can't do this. We have to get the nitrogen we need for our own proteins and DNA by eating the proteins, amino acids, and nucleic acids of plants or other animals. In this sense, nitrate is a good thing, because it is the preferred nitrogen source for plants.

In one of the wonderful examples of the way everything interacts, the natural microbes in soil tend to convert anything with nitrogen in it into nitrate. It's important to realize that all living things will give up nitrate as they decompose, and that the waste products of living things will also produce nitrate. This is a case where "going organic" is not an adequate solution. It will be extremely difficult, and expensive, to solve the nitrate problem.

When humans (and most animals) take up nitrate in food or water, most of it is quickly eliminated from the body through the urine. Nitrate is a water soluble compound and does not accumulate in body fat, as most herbicides and pesticides can do. However, if there is a constant intake of nitrate - as might be the case if your drinking water contains high nitrate levels - there will always be some nitrate present in the body. This is when health problems may occur.

Most people in rural areas are aware that nitrate is dangerous for infants. Nitrate is changed to nitrite in the stomach of babies because their stomachs are not as acid as older children and adults. This nitrite can then bind to hemoglobin in red blood cells, making it difficult for the blood to carry enough oxygen. Babies also have a slightly different form of hemoglobin (fetal hemoglobin), which is more sensitive to nitrite. Infants also lack an enzyme (called cytochrome b5 reductase) whose function it is to "clean" hemoglobin of anything that isn't oxygen. This makes the nitrate even more dangerous. Lack of oxygen in the blood can slow a baby's growth rate, and in the most severe cases can lead to brain damage, or even death.

It is less well known that some of these factors can affect children and people beyond infancy. For example, the elderly tend also to have lower acid levels in the stomach. So will anyone taking antacids, or some of the new

heartburn medications. People taking Viagra are also at risk if they consume too much nitrate. And there are people with abnormal cytochrome b5 reductase enzyme. Anyone with such conditions may experience lightheadedness or have trouble breathing if there is excess nitrate in the bloodstream.

Cancer is the other potential health threat arising from drinking water with high nitrate levels. Medical research has shown that excess nitrate (or nitrite) in the blood can react with amino acids that are also present, forming cancer-causing compounds called nitrosamines. There is disagreement in the medical literature whether elevated nitrate levels in the blood correlate with increased risk for cancer. However, there does seem to be an increased risk for stomach and bladder cancers, cancer of the thyroid, and non-Hodgkin's Lymphoma from long term consumption of excess nitrate.

There are three additional health problems where nitrate may be a factor:

- 1) Risk for miscarriage. The developing baby is fed by the mother, but if the mother herself is consuming excess nitrate, some may be passed to the fetus. This seems to be a risk only where the nitrate level in the drinking water is very high. The only published report concerning nitrate as a risk for miscarriage comes from a farming region in Indiana. It has been known for years that consumption of excess nitrate leads to miscarriage in farm animals, but the animals in these studies were fed nitrate twenty to 100 times higher than anything humans will encounter (grasses and corn plants store nitrate in their tissues and may contain up to 1000 ppm nitrate).
- 2) Breathing problems in children. A recent study from India was described in an article in *Environmental Health Perspectives*. Children from 5 different villages with nitrate levels from half to 10 times the EPA safe limit for nitrate were checked. The researchers found that these children had much greater numbers of serious respiratory infections than similar children from nitrate-free villages. Other studies link elevated nitrate levels with childhood asthma.
- 3) Childhood-onset diabetes. This is another health issue where the research is not clear, but some research groups have demonstrated that there seems to be an increase in the occurrence of early onset diabetes with elevated nitrate in the drinking water.

We all feel that there are just too many things we need to worry about these days. So why add something as simple and common as nitrate to the ever-growing list? We may encounter dozens of potentially hazardous or toxic compounds every day. But nitrate is an important water quality problem in many parts of the US (and worldwide), especially in agricultural regions and in times of drought. Nitrate has no taste or odor, and it is not removed by most water treatment systems or by boiling. **As a consumer of water**, you need to know if your water source contains excess levels of nitrate. If you have a well, call your local county's public health lab about getting your water tested.

References:

To collect information for this article, I went to a website that is run by the National Library of Medicine (part of the National Institutes of Health, US Department of Health and Social Services). This site collects the abstracts (summaries) of all articles since 1990 from most of the medical and health-related science journals from around the world, of which there are hundreds. (Here's the website address: <http://www.ncbi.nlm.nih.gov/Entrez/>) I searched using the term "nitrate and health" - which resulted in 216 articles. The term "nitrate and disease" resulted in 1,349 articles. Although many of these scientific papers are not entirely relevant to the question of whether there are health risks from consumption of excess nitrate, the large number of articles is an indication that it is indeed an area of concern. And there are studies from all over the globe: Finland, Taiwan, Canada, India, Britain, Germany, Japan, Russia, France, etc., in addition to the US. Our company also maintains an archive of articles on nitrate: www.nitrate.com, go to the "nitrate and health" and "nitrate in the news" sections.