

## ODH/HAS

Health Assessment Section

# Nitrates and Nitrites

## Answers to Frequently Asked Health Questions

### What are Nitrates/Nitrites?

Nitrates and nitrites are chemicals that occur naturally in the environment. They are created when animal wastes are decomposed in the soil or water by microbes to form ammonia. This ammonia is then changed to nitrite and nitrate. Because nitrite is easily oxidized into nitrate, nitrate is the form that is generally found in groundwater and surface water. Another way that the water can be contaminated by nitrate is through the use of nitrogen-containing fertilizers or products containing large amounts of ammonia and urea.

### How Can I Be Exposed to Nitrate/Nitrite?

In agricultural areas, nitrates are a major source of contamination for shallow groundwater aquifers that provide drinking water. People can also be exposed to nitrates by eating vegetables. Although they are seldom a source of acute toxicity, vegetables account for more than 70% of the nitrates in a typical human diet. Cauliflower, collard greens, broccoli, spinach, and root vegetables have a higher nitrate content than other plant foods. Meat and meat products also contain sodium nitrate which is added as a preservative and color-enhancer. Nitrate is used in foods to prevent botulism, a serious life-threatening food-borne disease

### What Happens to Nitrate/Nitrite in My Body?

Nitrate, when consumed, is absorbed rapidly from the small intestine into the blood and then spread throughout the body. Nitrate then enters the large intestine from the blood. If certain conditions exist in the intestine, such as a low pH, the nitrate is simply metabolized and excreted without apparent harmful effects. However, under other intestinal conditions, the nitrate will be changed into nitrite. This nitrite is then reabsorbed into the blood where it reacts with the iron of hemoglobin to form methemoglobin. This condition is known as methemoglobinemia. Methemoglobin is unable to transport oxygen, so the person who experiences this reaction can become oxygen deprived.

### What Levels of Nitrate/Nitrite are Recommended?

The U.S. Environmental Protection Agency (EPA) requires that the amount of nitrates in drinking water be less than 10 ppm (parts per million) when measured as nitrogen in nitrate.

### Can Nitrate/Nitrite Make Me Sick?

It is hard to know what levels of nitrates and nitrites can cause specific health effects. The kinds and severity of human health problems that occur with exposure to nitrates/nitrites depend on many factors:

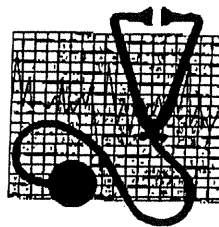
- How much nitrate/nitrite you were exposed to
- How long you were exposed
- How many times you were exposed
- How you were exposed (inhalation or drinking)

### What Factors Affect Health Risks?

- Past chemical exposure
- Smoking, drinking alcohol, or taking certain medicines or drugs
- Current health status
- Being allergic to certain substances,
- Age, weight, sex, family health history

### Short-Term Exposure Effects:

- Nausea, diarrhea, and vomiting, followed by
- Dizziness, blurred vision, breathing disturbances, and progressive muscular paralysis (nervous system symptoms)



Symptoms usually develop 18–36 hours after the nitrate is consumed, but they can occur within 2 hours or as long as 14 days later.

People most at risk are infants less than 4 months old who are fed formula diluted with water containing nitrate levels above the standard. Infants are more sensitive to nitrates because they have a higher intake of water for their body weight. Also, infants' blood contains a form of hemoglobin (fetal hemoglobin)

changed into methemoglobin than is adults' hemoglobin. In addition, infants' digestive systems have a higher pH, which enhances the conversion of nitrates into nitrites.

Pregnant women may also be more sensitive to nitrates because their blood contains higher levels of methemoglobin. They may be especially sensitive at around the 30<sup>th</sup> week of pregnancy.

### Signs and symptoms of methemoglobinemia (associated with the percentage of oxidized hemoglobin in the blood):

- 10-20% Some areas of the skin look blue
- 20-45% Nervous system depression (for example, headache, dizziness)
- 45-55% Coma, convulsions
- Over 70% High risk of mortality

### Long-Term Exposure Effects: Can Exposure to Nitrate/Nitrite Cause Cancer?

Nitrates (usually when used as preservatives and color-enhancing agents for meats) can react with amino acids to form nitrosamines, which can cause cancer in animals. So far there is no conclusive evidence that this effect occurs in people.

Again, some people are more susceptible and will be more easily affected by nitrate/nitrite than most people. Genetic makeup, developmental stage, age, health, and nutrition can contribute to different or increased response to nitrate/nitrite. Also, cancer patients, whose hemoglobin is sensitive, and people with reduced stomach acidity, such as those being treated for ulcers might be unusually susceptible. Except in infants, methemoglobinemia is generally not fatal and can be treated without lasting effects.

### Will Exposure to Nitrate/Nitrite Cause Reproductive or Developmental Effects?

Young infants may develop labored breathing, respiratory exhaustion, hypotension, below-average weight gain, and may fail to meet developmental milestones. Gastroenteritis, an inflammation of the stomach and intestines, can increase the rates of production and nitrites in young infants.

### Is There a Test to Find Out If I Have Been Exposed to Nitrate/Nitrite?

There are several tests which measure exposure to nitrates/nitrites. Most commonly, a drop of the patient's blood is placed on a piece of filter paper beside a drop of blood from an unexposed person. When dry, the blood containing methemoglobin-containing blood will be deep chocolate brown or slate grey in comparison. Also, a tube of methemoglobin-containing blood will not turn red when shaken in the air. Several of the tests that are used require more specialized equipment.

### What Treatment is There for Nitrate Exposure?

People with blood methemoglobin levels less than 20%, with no symptoms, do not require treatment. People having moderate to severe symptoms should receive 100% oxygen immediately. Other therapies for severe symptoms include intravenous methylene blue administration and blood transfusion.

### References

Agency for Toxic Substances and Disease Registry, Nitrate/Nitrite Toxicity, October, 1991.

Toxics A to Z, University of California Press, 1991.

Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2<sup>nd</sup> edition, Noyes Publications, 1985.

### Where Can I Get More Information?

#### Please contact:

Health Assessment Section  
Ohio Department of Health  
246 North High Street  
Columbus OH 43215  
Phone: 614-644-6447  
Fax: 614-644-7740

Developed under cooperative agreement with the Agency for Toxic Substances and Disease Registry.





# Ohio Department of Health Bureau of Environmental Health

## Treatment Technologies for Removing Nitrates in Drinking Water

Bob Taft, Governor  
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"To improve and protect the health of all Ohioans"

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If you detect nitrate concentrations in your drinking water at or above 10 mg/l contact a reputable water treatment dealer to discuss treatment options for the removal or reduction of nitrates. There are three cost-effective methods for removing nitrates from drinking water.

1. **Reverse Osmosis (RO)**
2. **Anion Exchange**
3. **Distillation**

### **Reverse Osmosis**

Reverse osmosis systems are typically used at the tap as a point of use (POU) treatment device. RO works by forcing water under pressure through a semi-permeable membrane that removes many chemicals at the molecular level. RO units that are used for removing nitrates should have a thin film composite membrane (TFC). RO units using TFC membranes can reduce nitrate concentration by 60 to 95 percent. When nitrate levels exceed 30 mg/l RO becomes less effective and other alternative treatment systems should be considered. Do not use RO units that use cellulose acetate membranes for nitrate removal for drinking water.

### **Anion Exchange**

These devices are used for whole-house treatment. They work much the same way a water softener does. Use an anion exchange resin that has a preferential affinity for nitrates to exchange chloride for nitrates. Note that when an anion exchange treatment system is used for nitrate reduction the total combined concentration of nitrates and sulfates in the water must be known. The resins used in nitrate removal systems have a preferential affinity for sulfate. This means that nitrates that have already been removed from the water will be re-released back into the drinking water in favor of sulfates when the resin has reached capacity. Also, in order to ensure the most efficient reduction of nitrates, a water softener should precede the anion exchange system to reduce the potential for fouling the nitrate anion exchange resin.

### **Distillation**

Distillation works through the evaporation of water. Condensed water vapors are collected as drinking water leaving behind non-volatile chemicals such as nitrates and lead. This type of treatment is not economical for whole-house treatment but can be used to treat small amounts of drinking water. One potential problem associated with distillation however, is that volatile compounds, if present, might be carried along with the evaporated water and would remain in the treated water.

### **Testing**

Test your water for nitrates periodically because nitrates have no detectable taste or odor. Nitrate levels may fluctuate seasonally, therefore conduct additional periodic testing if there is a history of nitrate levels close to or above 10 mg/l.

Please contact the Bureau of Environmental Health at (614) 466-1390 with questions.