

# Nitrate and Nitrite

## Sources

Nitrate and nitrite are naturally occurring chemicals in the environment. Nitrate ( $\text{NO}_3^-$ ) is an important plant nutrient and found at different concentrations in all plants. Nitrite ( $\text{NO}_2^-$ ) is not usually found in significant concentrations in the environment, since nitrate is the more stable chemical.

Nitrate is commonly used in agricultural fertilizers, and nitrite is used as a food preservative, especially in processed meat.

Nitrate in groundwater and surface water is normally low, but can reach high levels if there is leaching or runoff from agricultural fertilizers or from human and animal feces. Nitrite is formed as a result of microbial activity in soil and the levels in water can vary.

Nitrite can also be formed in water distribution pipes by *Nitrosomonas* bacteria if the water is stagnant and without a lot of oxygen, or if chloramine is used to treat the drinking water and provide a residual disinfectant.

## Potential Health Effects

High nitrate and nitrite levels can cause serious illness by acute exposure. The main health concern is methaemoglobinaemia, or blue baby syndrome, which occurs in infants that are bottle fed with formula prepared with drinking water. It causes them to have difficulty breathing and their skin turns blue from a lack of oxygen. It is a serious illness that can sometimes lead to death.

Babies with methaemoglobinaemia often also have gastrointestinal illness (e.g., diarrhea) at the same time. This is because high nitrate levels are often associated with higher levels of microbiological contamination from manure or sewage.

## World Health Organization Guidelines

The World Health Organization (WHO) suggests that drinking water should have less than 50 mg/L of nitrate and 3 mg/L of nitrite to protect against methaemoglobinaemia in bottle fed infants (short-term exposure). In addition, the sum of the ratios of the concentrations of each to its guideline value should not exceed 1 (WHO,2017).

For example, a drinking water sample contains 30 mg/L nitrate and 1.5 mg/L nitrite. Does the sum of the ratios of the concentrations exceed the guideline value?

$$\frac{30 \text{ mg/L nitrate (water sample)}}{50 \text{ mg/L nitrate (WHO guideline)}} = 0.6 \quad \frac{1.5 \text{ mg/L nitrite (water sample)}}{3 \text{ mg/L nitrite (WHO guideline)}} = 0.5$$

Add the ratio of the concentrations together:  $0.6 + 0.5 = 1.1$

1.1 is greater than 1, so this drinking water sample exceeds the WHO guideline value.





In most countries, nitrate levels in surface water are not more than 10 mg/L, although nitrate levels in well water often exceed 50 mg/L. The WHO guideline was set specifically for bottle fed infants who are most vulnerable to nitrates and nitrites in drinking water. Therefore the guideline value is more than adequately protective for older children and adults (WHO, 2017).

**WHO Guideline for Nitrate in Drinking Water <50 mg/L (short-term exposure)**

**WHO Guideline for Nitrite in Drinking Water <3 mg/L (short-term exposure)**

### Water Quality Testing Methods

Nitrate and nitrite can be tested using a commercial laboratory or portable test kit. Portable digital photometers are available from various commercial manufacturers. These can provide reliable and quantitative measurements of iron (UNICEF, 2008). Nitrate and nitrite can also be measured using test strips or a colour disc comparator.

Information about commercially available test kits are provided in CAWST's Drinking Water Quality Testing Product Sheets.

### Household Water Treatment Options

The best way to deal with nitrate and nitrite in groundwater or surface water is to use a different source of drinking water, such as rainwater. Some people collect and store their rainwater and use it for drinking, cooking, and preparing baby formula. If people change their water source from groundwater to surface water, they will probably need to treat the surface water to remove turbidity and pathogens.

High nitrate levels are often associated with higher levels of microbiological contamination since the nitrates may have come from manure or sewage. If high levels of nitrate are detected, then people should also treat their water to remove the potential microbiological contamination.

### References

UNICEF (2008). UNICEF Handbook on Water Quality. UNICEF, New York, USA. Available at:

<https://www.unicef.org/media/91301/file/Handbook-Water-Quality.pdf>

World Health Organization. (2003). Nitrate and nitrite in drinking-water: background document for development of WHO guidelines for drinking-water quality. Available at:

<https://apps.who.int/iris/handle/10665/75380>

World Health Organization (2017). Guidelines for Drinking-Water Quality, Fourth Edition Incorporating the First Addendum. WHO, Geneva, Switzerland. Available at:

<https://www.who.int/publications/i/item/9789241549950>



This document is open content. You are free to:

- Share – to copy, distribute and transmit this document
- Remix – to adapt this document

Under the following conditions:

- Attribution. You must give credit to CAWST as the original source of the document. Please include our website: [www.cawst.org](http://www.cawst.org)

CAWST and its directors, employees, contractors and volunteers do not assume any responsibility for and make no warranty with respect to the results that may be obtained from the use of the information provided.



B12, 6020 – 2 Street SE  
Calgary, Alberta T2H 2L8  
Canada  
+1 (403) 243-3265  
[resources@cawst.org](mailto:resources@cawst.org)  
[cawst.org](http://cawst.org)

To stay up-to-date and get support on:

- The latest updates to this document
- Other workshop and training related resources
- Using this document in your work

Visit [resources.cawst.org](http://resources.cawst.org)