

What nitrates are and the effects they have on humans

The molecular formula of Nitrate is NO_3^- and the compound is defined as a polyatomic ion whose molecular mass is 62.0049 g/mol. Nitrate is a compound with no taste, no odor and no color[1]. Moderate amounts of nitrates can be harmless when in drinking water and food. Nitrates do accumulate in the stems and leaves of plants. Nitrate is highly mobile and because of this it easily leaches into groundwater[2].

Effects on Human Health

Nitrates do have negative as well as some positive effects on the health of humans. Before they enter the body, nitrates are harmless but they only tend to be harmful to health when they enter the body. The problem arises when nitrates are converted to nitrites and this happens to 5 percent of the nitrates ingested into the stomach. The remaining percentage of nitrates still converts into nitrites when they get to the intestines and this can be a limiting factor to the amount of nitrates absorbed by the body.[3]

It is widely accepted that the ingestion of nitrates has the effect of widening the arteries. The bacteria present in the intestines and the mouth reduce nitrate to nitrite which when exposed to nitric oxide synthase turns to **nitric oxide** - the relaxing factor derived from the endothelium. This is the reason why sublingual nitrate could be the antidote to an angina pectoris episode. Researchers have also collected evidence to suggest that nitrate can reduce blood pressure. According to Hord et al cited in [4], vegetables have the ability to lower the blood pressure. This was revealed through the Dietary Approaches to stop Hypertension Trial (DASH). However, there is no sufficient evidence to suggest that the amount of nitrates available in vegetables can be useful for lowering blood pressure. There are also insufficient indications that dietary nitrate can cut down cardiovascular disease cases.

Concerns have also been raised about the relationship between nitrates and the formation of cancer cells. Inside the body, nitrates and their derivatives called nitrites do not cause cancer. However, nitrites formed from nitrates consumed through the diet might undergo a reaction when in contact with dietary amines to produce cancer causing nitrosamines. Researchers have demonstrated these effects in animal tests but due to the extremely high doses of the amines used, there is no certainty about their relevance to humans.[5] In certain studies where observations have been made, the consumption of nitrates through water or food does not have any association with cancer in people. The effect of externally formed nitrites on cancer has a very small possibility because of the quantities of nitrite form within body tissues.

Fasting saliva has approximately 2 mg/L, and when a quantity of spinach equivalent to 200 grams of spinach is eaten there can be a rise in the concentration of saliva to a high of 72 mg/L. This is extremely higher compared to the EPA drinking water standard of 4.4 mg nitrite/L or even the daily intake acceptable by the World Health Organization (WHO) of 4.2 mg nitrite/d. [6] This means that the available evidence for harmful effects of nitrate and nitrite eaten through the diet is not convincing and therefore, any intake above the acceptable limits could as well not have any harmful effects. Authorities have willingly accepted this possibility because making an error on the safer side even with nitrates is justifiable if it maintains one true cancer causing substance out of the food. [7]

An ecologic study about a certain incidence of cancer in the UK did not establish a relationship between the exposure to nitrate and gastric cancer. However, **higher occurrence of cancer** in the brain and CNS were

found to exist in places with high concentrations of nitrate.[8] Nitrates in drinking water can cause non-Hodgkin lymphoma. In 1992, Kostraba et al cited in [9] suggested that exposure to low levels of nitrate could have a role in the etiology of diabetes mellitus which is insulin-dependent. In a study done at the University of Leeds in 1997, it was reported that there was an increase in the risk of diabetes in children from a level of 1.00 at a nitrate concentration of below 3.22 mg/L up to a level of 1.27 at nitrate concentrations greater than 14.85 mg/L.[10] Exposure to nitrates may also be a contributing factor to thyroid disease development.[11]

Nitrate toxicity affects humans especially infants who often suffer from methemoglobinemia which is a condition that affects children below six months. This condition is common in infants and not humans in other stages of life because infants have very high concentrations of nitrate metabolizing triglycerides. In infants, methemoglobinemia is called blue baby syndrome. At one point in time, it was believed that this condition is partly caused by nitrates dissolved in drinking water. Although nitrates play a role in the formation of methemoglobinemia, scientists have confirmed that there are other factors that highly contribute to the occurrence of this condition [12]. These include those factors that cause protein intolerance, diarrheal infection and heavy metal toxicity. Infants ingest nitrates through nitrate drinking water. Some adult people may have a higher susceptibility to nitrate effects on health than others. In some people, there may be the under-production or total absence of the enzyme methemoglobin reductase. This is normally the result of an inherited mutation within the genes. Such people lack the ability of breaking down methemoglobin at the same speed as those who have the enzyme [13]. This leads to higher levels of circulation of methemoglobin in their blood. This implies that the amount of oxygen in their blood is little. People lacking enough stomach acid risk getting the condition. Vegetarians have a high risk as well because of consuming high levels of green, leafy vegetables. So many medical conditions, such as gallstones, allergies, asthma and hepatitis result from low amounts of acid in the stomach and such people may have high sensitivity to nitrate effects.

Pregnant women exhibit show a lot of sensitivity to the effects caused by nitrates because of the increase in the levels of methemoglobin in the blood in the later pregnancy stages starting about week 30.[14] People with rare hereditary conditions and with above normal amounts of methemoglobin are at a greater risk. Epidemiological studies done on pregnant women with high levels of nitrates in their drinking water have not shown evidence of effect on their unborn babies. Only one isolated study showed that there was an association between defects in neural tubes and nitrates.

The acid in children's stomachs is weaker than that in older children or adults. This results in increased bacterial levels that can successfully turn nitrates to nitrite. Infants should not be allowed to drink water that goes beyond 10 mg/l NO_2^- -N. The blood absorbs the nitrite and this brings about the conversion of hemoglobin into methemoglobin. Unlike hemoglobin, methemoglobin cannot do efficient transportation of oxygen. This causes a lower supply of oxygen to major tissues including the **brain**. In the blood of an infant, methemoglobin cannot be turned back to hemoglobin, something that can occur in the body of an adult [15]. When methemoglobinemia becomes too severe, it can cause brain damage and eventually death. Symptoms of methemoglobinemia include a bluish skin color, especially on the mouth and eyes [16]. It is possible for healthy adults to take in huge nitrate amounts and suffer very few known effects on their health. Nitrates consumed through vegetables are absorbed into the body and excreted via the urinary tract with urine. However, consuming high nitrate levels for a long time could cause gastric problems because of the formation of nitrosamines. In tests done on animals, N-nitrosamine compounds were found to be a

cause of cancer. Studies on people with high exposure to nitrates and nitrites do not show that there is a high risk of cancer among those involved in the studies [17].

The contamination of surface water with nitrates causes eutrophication. This is the excessive growth of plants in surface water that results from excessive inflow of nutrients. This inflow compromises the quality of water through pollution and consuming this water could have adverse effects on human health including causing diarrhea and other waterborne diseases. Water polluted through eutrophication could harbor dangerous microorganisms that are responsible for causing infectious diseases. The foul smell created by algae in water polluted with nitrates is also harmful to health [18].

Notes

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