

NITRATES and NITRIC ACID

Nitric oxide (NO) is a gaseous signaling molecule which is vital to our health, especially cardiovascular health. As a gas, it penetrates into cells easily and quickly. It acts as a signaling molecule in every cell and organ in our body. Although more known for regulating blood flow and oxygen delivery and maintaining normal blood pressure, it has other vital functions as well. It is a neurotransmitter in the central nervous system. It helps us fight off pathogens through the immune system. There is no test to measure it accurately however you can use a saliva test strip to see if levels are normal or not. There is also no good medical therapy for deficiency in NO. Only lifestyle changes will do that.

Here is a list of some of some of its benefits and functions:

- Prevents high blood pressure
- Keeps arteries flexible
- Prevents clots from forming
- Prevents arterial walls from thickening
- Reduces and prevents arterial plaques
- Lowers triglycerides
- Reduces risk of diabetes
- Limits pain and swelling from arthritis
- Boosts the power of pain-relieving drugs
- Reverses erectile dysfunction
- Calms asthmatic inflammation
- Improves bone density
- Signals the immune system into action
- Helps provide the mood-lifting power behind antidepressant medications
- Limits skin damage from the sun

NO has a half-life of about 1 second and it comes from 2 places. First and foremost, we make it. It is made by our endothelial cells, the delicate innermost single layer of cells which line all of our arteries. NO is generated from the amino acid L-arginine, which is why this is called the L-arginine pathway. The byproducts of L-arginine metabolism is NO and another amino acid, citrulline. In addition to the vast vasculature of the nose and sinuses which also produce NO, the same active enzyme, endothelial NO synthase (ENOS), is located in the epithelial lining of the sinuses, generating NO. Secondly, we make it from various plants we consume, called the nitrite-nitrate-NO pathway. The latter becomes more important as we get older since our capacity to generate NO decreases with age. We lose about 10-12% production with each decade of life so by age 50, you make only about 50% of what you made in your 20's and 73% less by age 80. This decline has partly to do with loss of the ability to convert the amino acids L-arginine and L-citrulline by NO synthase into NO. Despite supplements for those amino acids promote good vascular health, the presumes you still have functioning enzymes, so, in other words, save your money. The healthy bacteria in your mouth, teeth, grooves of your tongue, are crucial to the process. They convert the nitrate from vegetables into nitrite. When you swallow the nitrite, your gastric acid converts the nitrite into NO. There are certain practices which impair our ability to make nitric oxide from our foods.

1. Using mouthwashes, especially ones which contain alcohol, as well as fluoride in toothpaste and mouth rinses, destroy those essential, healthy bacteria, located on the back part of the tongue. We are obsessed with minty fresh breath and bacteria in our mouths. Bacteria is supposed to be there. They start the process of digestion. When you use mouthwashes, you might have minty breath for a short period of time but in the meantime, you kill the healthy bacteria which

convert nitrites into nitrates. In addition, you create a microbial imbalance which itself causes bad breath! In addition, there is a significant link between using mouthwashes and type 2 diabetes and even heart disease.

2. Antacids. These impair the function of the stomach enzyme responsible for converting the nitrate into nitric acid. Almost 2/3rds of Americans are on acid reducers regularly, mostly for reflux. The irony is that they do not treat reflux, which is when stomach contents refluxes back up into the esophagus, sometimes even reaching your throat, mouth or even sinuses. These medications actually worsen reflux by masking the symptoms. In addition, acid reducers cause numerous nutrient deficiencies by impacting on absorption and have been shown to contribute to dysbiosis, disruption of the gut microbiome and function.

In addition to the above risk factors, other poor lifestyle habits like smoking, drinking too much alcohol and an unhealthy diet “uncouple”, or disrupt ENOS’s ability to make NO. All the usual lifestyle related diseases like diabetes, obesity, and hypertension also lead to uncoupling of ENOS so it’s a vicious cycle. Disease begets more disease. In fact, it leads to ENOS producing a competitive, pro-oxidant, peroxynitrate, which is not good for your health.

Nitrate from our food gets absorbed and concentrates in our saliva, where concentrations are 100x more than what is in your circulation. It’s nature’s way of protecting us from after-meal (post-prandial) inflammation caused by digesting and breaking down of more complex foods like protein and complex carbohydrates. It explains why we eat salad before a meal. This cycle is called the “enterosalivary nitrate circulation”. Each time you make saliva, nitrate enters the mouth and the bacteria have an opportunity to convert it into nitrite once again. Those bacteria also use the nitrate as an energy source.

Other risk factors which lower NO production include smoking, eating an inflammatory diet including processed foods and sugar and a sedentary lifestyle.

Vascular disease gets its inception when we progressively injure the endothelium of our arteries. NO does a number of things when it comes to vascular health.

1. It keeps all the cellular and nutritional elements in our blood vessels flowing smoothly. It’s like Teflon for our arteries. When our arterial walls are damaged, mostly by a poor diet and lack of exercise, the walls are more like Velcro, slowing blood flow and letting plaques form.
2. It’s the strongest blood vessel dilator in the body. When you climb a flight of stairs, it’s the NO which helps the arteries dilate, increasing blood flow to your muscles.
3. It protects the walls of the artery preventing them from thickening.
4. It protects the arteries from developing plaque

Chewing leafy greens is the best source of nitrates. Adding acetic acid from vinegar such as balsamic and red wine vinegar, restores the nitric oxide synthase enzyme which is in the arterial endothelial and sinus epithelial cells. Greens also restore the capacity of the bone marrow to produce endothelial stem cells which replace our aging endothelial cells. Chewing greens is better than blending because, in addition to breaking down the cell walls and generating more surface area for breakdown in the stomach, chewing exposes the greens for longer periods of time to the beneficial bacteria in the mouth. If you take nitrate, which is what you get when you eat greens for example, it takes 90 or so minutes to go through the whole conversion mechanism to generate NO in the stomach. NO or nitrite, however, has a much faster effect.

The top 5 greens which contain nitrates are:

- Kale,
- Swiss Chard,
- Spinach, Arugula and
- Beet Greens.

Other vegetables high in nitrates are:

- Beets,
- Radishes,
- Turnips,
- Celery,
- Onion and
- Garlic

Some fruits do contain nitrates, but the amounts are generally low. These include:

- Watermelon (very high in the amino acid citrulline which also is a precursor to NO),
- Apples,
- Bananas,
- Grapes,
- Kiwi fruit,
- Nectarines and peaches,
- Pears,
- Oranges and
- Strawberries

There is a significant difference in the amount of nitrates in foods depending on where and how they are grown. There is as much as a 100x difference in the amount of nitrates in those vegetables. This has mostly to do with soil health and particularly lack of healthy nitrogen in the soil from years of bad farming practices and previous use of chemicals. Surprisingly, organic vegetables may have lower levels of nitrates, up to 10x less than conventionally grown food because of the chemicals, particularly nitrogen-based fertilizers (NPK - Nitrogen Phosphate Potassium). These add nitrates to the foods because there is more, albeit artificially sourced, nitrogen in the soil for the plants to take up. Many other nutrients in foods depend on nitrates in the soil for proper absorption which is why regenerative farming, the techniques which restore the soil are imperative, not just organic farming.

Nitrate is inert in humans. Converting nitrate into nitrite is 100% dependent on bacteria, primarily oral bacteria. There are 200 million Americans, 2/3rds of the country, waking up every day using an antiseptic mouthwash. This is doing much more harm than good. When you use a mouthwash, your blood pressure goes up. 2/3rds of American have hypertension and there is clearly an important connection between the oral biome and systemic hypertension. In addition, 2/3rds of Americans are on an oral antibiotic at any given time, which also impacts on oral bacterial health. As a result, nitric acid production is significantly impacted by mouthwashes and antibiotics. Mouthwashes result in you losing the vascular benefits of exercise. Fluoride is also an antiseptic antimicrobial and a neurotoxin.

To get us from nitrite to NO requires stomach acid. 2/3rds of Americans are on prescription acid reducers. That doesn't even count the over-the-counter acid reducers. The blood pressure lowering effects of ingested nitrates are eliminated by these medications. In addition, they impact on your natural endothelial production of NO. So, these antacids impact on both pathways which make NO. We

also know now that people who have been on antacids for 3-5 years have a 35% greater incidence of heart attack and stroke.

The penis and the vagina have the greatest concentration of endothelial cells in the body. Proper blood flow leads to proper genital function and impairment of endothelial function results in erectile dysfunction and diminished sexual function in women.

50% of your nitric oxide comes from endothelial cells and 50% of that goes away by the time you are 50 years old. This NO production also drops based on lifestyle, as I mentioned above. So, a sedentary, obese 5-year-old, eating sugar, processed food and limited fruits and vegetables can have the same endothelial health, and NO production of a 50-year-old. Even within 1-2 days of changing your diet, NO production increases. The problem with most Americans is not that they are overeating meat, although they are, it is really about not eating enough fruits and vegetables.

Ways to increase NO production also include:

1. Deep nasal breathing. The sinus epithelial lining contains the same NO Synthase enzymes as the endothelial cells have in the lining of our arteries. It is impaired by the same behaviors which impair endothelial NO production as well. Deep nasal breathing activates the mechanoreceptors on these cells which then generate NO. Simply deep breathing deeply through your nose, lowers your blood pressure.
2. Hydration. When you are dehydrated, your cells become dysfunctional. But you must consume filtered water. Chloride, fluoride, various other chemicals... All impact on your body's function.
3. Good Sleep. Sleep is when the body heals. Sleep apnea also hugely impacts on cardiovascular health. By not breathing well, you don't make NO. Magnesium also helps with sleep. 85% of Americans are deficient in magnesium which is involved in at least 187 different biochemical reactions. Magnesium is calming. 500mg of magnesium a night is calming and helps with sleep.
4. Avoid acid reducers, statins and NSAIDS, all of which impair NO production.
5. Exercise increases NO production. However, once you run out of oxygen, the anaerobic threshold, at which point lactic acid starts to build up, NO production shuts down. If you can titrate your levels up prior so that when that pathway of NO production stops working, then the reservoir of nitrate and nitrite can be reduced to nitrite specifically under low oxygen conditions. That's the buffer system. NO, when given as a supplement through a machine 3 minutes before a time trial on a bicycle, increases speed by 3%. Although this may not sound like a lot, it is the difference between first and last in a race.