NITRATES and NITRIC ACID

Nitric oxide (NO) is a gaseous signaling molecule which is vital to our health. In fact, it may be one of the most important signaling molecules in our bodies. 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

Drugs like nitroglycerine, taken when people have chest pain, work by increasing NO leading to relaxation of the coronary arteries, improving blood flow and oxygen delivery to strained heart muscles. Viagra and other ED medications also work by increasing NO.

Secondly, we make NO from various plants we consume. This is called the "nitrate (NO3)-nitrite (NO2)-NO pathway". The latter becomes more important as we get older since our capacity to generate NO decreases with age.

NO has a half-life of about 1 second and it is generated through 2 pathways.

First and foremost, we make it. It is made by our endothelial cells. These cells are the delicate innermost single layer of cells which line all our arteries throughout our body which, when laid out flat, would cover a soccer field. NO is generated from the amino acid L-arginine, which is why this is called the "L-arginine pathway". In addition to the vast vasculature of the nose and sinuses which also produce NO, the same active enzyme, NO synthase (NOS), also known as endothelial relaxing factor, is produced in the epithelial lining of the sinuses, generating NO. There are 3 types of NOS.

1. Neuronal NOS (nNOS), which is made in the vasculature of the brain.
2. iNOS. Inducible NOS, generated by our immune system cells.
3. eNOS. Endothelial NOS, the most common one which is in our endothelial cells.

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Our ability to produce NO through the internal pathway drops by about 10-12% 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. There are many things which impact this decline, including simple aging, but other factors play a more significant role. Chronic disease, smoking, lack of exercise… all the usual lifestyle suspects reduce our ability to make NO. 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. Although supplements for those amino acids promote good vascular health, this presumes you still have functioning enzymes and bacteria, 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 very common 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.

   Also remember that municipal water contains fluoride, as well as chlorine. Although these make the water drinkable by killing pathogenic bacteria, they also kill the bacteria in our mouths and gut and also contribute to NO dysregulation.

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.

3. High fat diets. Consumption of just one fatty meal impaired production of NO and measurably impacted on arterial function for as long as 4 hours. That's why it is not that uncommon for people to have heart attacks after a fatty steak or pizza. If you have 3 fatty meals in a day, your arteries never recover. WATCH THE FAT!

Nitrate from our food either gets converted into NO or about 25% of it gets reabsorbed in the small intestines 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 more complex foods like protein and complex carbohydrates. It explains why we eat salad before a meal. This cycle is called the "entero-salivary 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 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 performs a number of tasks 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 (which has the absolute highest NO index by 3x)
- Swiss Chard (#2 in NO index)
- Arugula
- Spinach and
- Beet Greens.

Concentration of nitrate is highest in the petiole (stem of the leaf), followed by the leaf itself, the actual plant stem, the root, the flower, the bulb, the fruit and lastly the seed.

Other vegetables high in nitrates include:

- Beetroot
- Radishes
- Turnips
- Celery
- Onion and
- Garlic

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

- Watermelon
- Apples
- Cacao (dark chocolate)

- Bananas
- Grapes
- Kiwi fruit
- Nectarines
- Peaches
- Pears
- Pomegranate
- Oranges
- Strawberries

Adding lemon or lime, both rich in vitamin C, to a salad or meal significantly increases the conversion of nitrate and nitrite into NO. Adding vegetables like peppers, also high in vitamin C, also help.

There is a significant difference in the amount of nitrates in the same species of plants depending on where and how they are grown. There can be 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 Americans 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 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, not only by impacting on production of NO from foods, but also by impairing the natural pathway in our vascular endothelium.
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. One last point about exercise is that if you consume products which npair NO production, the vascular benefits of exercise are essentially neutralized.