Why You Need 12 Bananas of Potassium Every Day

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January 2018

Potassium is the third most abundant mineral in the body so it is no surprise that a potassium deficient diet can lead to a slew of problems. The most common symptoms of potassium deficiency include fatigue, muscle weakness, and brain fog. In addition, supplementing potassium has been proven to stimulate neural activities like memorization and learning, help lower blood pressure, and reduce stress and anxiety. Potassium plays a vital role in maintaining water balance in the body, and a sufficient concentration is also required for regular contraction and relaxation of muscles.To an extent, a state of potassium deficiency can even be thought of as being intoxicated by alcohol - as both are characterized with poor muscle coordination, lapses in judgement, and potentially even poor memory. The daily recommended value is 4700mg - 12 bananas worth - of potassium, and I'm willing to bet that you're not getting enough of it on a consistent basis.

Neuron Communication

The nervous system is a complex collection of nerves and neurons that transmit signals between every part of the body. In charge of thoughts, actions, and emotions, the nervous system drives all aspects of human life. Nerve cells, or neurons, communicate with each other through both electrical and chemical signals. Outside of the neuron's cell membrane, there is a high concentration of positively charged sodium ions (1). Inside the neuron, there are also positively charged potassium ions, but there are even more negatively charged proteins that make the net charge inside of the neuron negative. Neurons in a state of rest like this have a negative membrane potential of about -70mV and are said to be polarized. To maintain this electrochemical gradient of positive charge outside of the cell and negative charge inside the cell, there is an all-important sodium potassium pump that allows sodium and potassium ions to move across the cell membrane. With the help of ATP (energy), for every two potassium ions that are pumped into the cell, three sodium ions are transported out. It has been estimated that as much as 20%-40% of the resting energy expenditure in adults is accounted for from maintaining this electrochemical gradient (1).

TL;DR if you don't want the nitty gritty chemistry of what is going on: When neurons receive a signal, ion channels open in the membrane of the cell, allowing sodium ions to flood into the

neuron. The movement of these positive ions results in a voltage difference across the membrane. A decrease in the voltage difference (depolarization) that exceeds a certain threshold generates an impulse that travels along the neuron (1). In cases in which these channels do not work properly or do not have adequate potassium to open and close, the nervous systems' ability to communicate becomes compromised. In the brain, in particular, this results in a diminished ability to remember or relay information (think).

There are other channels through which sodium and potassium ions can be transported across the cell membrane as well. There are large proteins that serve as ion channels that allow ions to move across the cell membrane when their gates open. These ion channels open and close their gates depending on their structure and purpose. Whereas most ion channels are voltage-gated channels that open at certain membrane potentials, there are also ligand-gated channels that open when latched onto by certain neurotransmitters or hormones as well as mechanically-gated channels that open when the membrane is physically stretched. Because nature prefers equilibrium and not electrochemical gradients, whenever these ion channels open up, the appropriate ions quickly diffuse across the channel to balance the concentration and charge on both sides of the cell membrane. The movement of these ions is what allows neurons to communicate with each other.

When neurons receive a signal or stimulus, sodium ion channels open in the membrane of the cell and sodium starts to enter the neuron. For an action potential (impulse) to occur, enough sodium has to enter the neuron to push the membrane potential past a certain threshold that is usually at -55mV. If the threshold is not met because the stimulus was not strong enough or for whatever reason, the neuron treats it as a false alarm and returns to its resting state with the help of the potassium sodium pump.

When the threshold is reached, however, the numerous voltage-gated ion channels open and allow sodium to start flooding into the neuron. The neuron becomes so depolarized that the voltage actually becomes positive and reaches about 40mV. This generates an impulse that travels along axon of the neuron and creates a chain reaction that signals other neurons down the line to fire off as well.

The process of a neuron returning to its resting state (repolarization) involves the potassium first leaving the neuron to balance the charge out (hyperpolarization) and then the sodium potassium ion pump transports the potassium back into the neuron until the neuron returns to its resting state (polarized).

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Potassium as a vasodilator

Potassium has also been shown to act as a vasodilator (5). When there is enough potassium present, blood vessels in the body relax and widen because the smooth muscle cells within the vessel walls relax (8). This allows blood to flow more freely, lowers blood pressure, and reduces the likelihood of blood clots and strokes, especially in the brain (3)(4)(9)(10).

As mentioned before, neurons on functioning potassium channels to transmit information through electrical signals, called action potentials or impulses. The voltage induced by the impulse depends on the concentrations of the potassium and sodium ions on either side of the cell membrane. Maintaining these ionic gradients consume a lot of energy and require a constant supply of glucose and oxygen to the neuron, especially for neurons in the brains. Dilated blood vessels also allow more oxygen to reach the brain, thus stimulating neural activity and increasing cognitive functions like memory and learning. It has been shown in rats, which have virtually identical ion channel gene sets to humans, that supplement of potassium significantly improved learning and memory deficits (2)(6)(7)(12).

Not only does potassium play a role in lowering blood pressure as a vasodilator, it stabilizes blood pressure as well. Potassium aids the process of reversing the role of sodium in unbalancing normal blood pressure and in effect, serves to maintain the normality of blood pressure in the body. Essentially, potassium alleviates the stress and anxiety induced by elevated blood pressure.

Alcohol and Sodium-Potassium Ion Pumps

A study by the University of Warwick showed that alcohol consumption warps body coordination by inhibiting the function of sodium-potassium pumps in certain neurons and regions of the brain, thereby directly hindering the nervous system's ability to communicate with neurons and muscles (16). This results in the common effects of alcohol intoxication: poor body coordination, lapses in judgement, and potentially even questionable memory. Thus, the symptoms of potassium deficiency can be thought of as being similar to the effects of alcohol intoxication. Alcohol, in sufficient quantities also acts as a vasoconstrictor - shrinking the blood vessels and increasing blood pressure - whereas potassium acts as the opposite, a vasodilator.

Oxidative Damage

Potassium has also been proven to prevent brain damage and potentially even prevent neurodegenerative diseases (an active area of research). A study published in 2013 in the "Journal of Neuroscience letters" showed that supplementing potassium significantly reduced the levels of free radicals in test subjects and thereby reduced the amount of oxidative damage

in the brain (14). Without getting too much into the complex chemistry of oxidation stress and the resulting oxidation damage, there are systems in our body (antioxidants and repair enzymes) that can target oxidative damage after it occurs, which can stop the damaging effects of oxidation stress, but neurons in the brain are different from neurons located elsewhere in the body. Neurons in our brain are much more vulnerable to oxidative stress, and damage can impair function immediately – which can lead to necrosis, or death, of neurons (13).

Maintaining Fluid Balance

Another significant role that potassium plays in our body is in maintaining the optimal fluid balance. Different types of cells in the body need different amounts of water for efficient functioning, and electrolytes like potassium are regulators of this balance. Consuming bananas, coconut water, or other foods high in potassium in addition to water before or after workouts isn't just to prevent cramping, the potassium also functions to help rehydrate the body and optimize fluid balance. This can also help alleviate hangovers after a heavy night of drinking (11).

Muscle Function/Growth

It is no secret that bananas can help prevent muscle cramping because of its high levels of potassium. That is because potassium is required for the regular contraction and relaxation of muscles. Most of the potassium ions in the body are also located in the muscle cells - it maintains optimal muscle and nerve function, and keeps our reflexes fast because the electrical signals from the brain and nervous system must travel through potassium ion channels. More potassium = faster communication.

Potassium also plays a role in facilitating proper muscle growth and strength. Essentially, muscle growth is driven by an increase in cell volume, which is important for getting amino acids inside the cell (17). Cell volume increases as a result of a two step process known as a muscle pump. The first step of the muscle pump functions as mentioned before, the sodium potassium pump moves three sodium ions out of the cell, in exchange for two potassium ions. The second step is a similar mechanism called the sodium-potassium-chloride co-transporter pump (NKCC), where one sodium, one potassium, and two chloride ions are transported into the cell from the outside. As a result of both steps of this muscle pump, there is a net gain of charged ions in the cell, which increases intracellular osmolarity. As intracellular osmolarity increases, extra water is pulled into the muscle, increasing cell volume (18). The muscle pump also drives amino acids into the cell. Amino acids are necessary in the cell to activate protein synthesis and are critical in repairing exhausted muscle tissues. For a more detailed breakdown on how potassium drives muscle growth, read more here: http://bit.ly/2EtfK7l

Foods Rich in Potassium

Fear not, however, because consuming adequate levels of potassium is not difficult. While the Food and Nutrition Board of the Institute of Medicine states that adolescents and adults (over 19) need a whopping 4700mg of potassium a day, there are plenty of rich sources of potassium - namely in fruits and vegetables (15). A medium-size banana has about 400mg, a medium-size orange has 200mg, a cup of coconut water has 600mg, a cup of cooked spinach has 800mg, a cup of cooked lima beans has 900mg, and a cup of broccoli has 500mg, etc. Meat, diary, and fish also contain a high amount of potassium: a cup of soy milk, nonfat, low-fat, or whole milk has 300mg, 3 ounces of cooked lean beef has 224mg, and 6 ounces of yogurt has about 350mg.

Disclaimer

There are many reasons why we should pay attention to what we eat, but in this age of information and all kinds of media, it is especially hard to discern what is factual and what is actually corollary. Many of the symptoms of potassium deficiency and benefits of potassium supplementation are intangible in our daily lives – it is hard to attribute mental fatigue and confusion to potassium deficiency when it can easily be blamed on a lack of sleep or exhaustion. However, I encourage you to try to understand the science behind how our nervous system communicates because the presence of sufficient potassium is vital in the function of our organs and bodily systems.

While at first thought potassium supplements sound good, they are limited to 99mg per capsule. You would need to consume 2 entire bottles of potassium supplements just to reach the daily recommended value - please don't do this. While it is actually possible to have too much potassium, hyperkalemia, it is rare and mostly occurs only for people with kidney problems.

By diversifying and eating a wholesome diet complete with vegetables and fruits, it is not hard to reach the daily recommended value of potassium and have an efficiently functioning nervous system. And please, I cannot stress this enough, do not eat 12 bananas a day.

References

For further reading on other benefits of potassium, as well as a more detailed breakdown of the chemistry surrounding potassium, read this article published by Oregon State University: http://lpi.oregonstate.edu/mic/minerals/potassium#reference29

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