

# Makes You Age Faster, Even if You Look OK Now

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## STORY AT-A-GLANCE

- › The levels of vitamins and minerals required to diminish disease may not be the same as the levels required to optimize longevity; in many cases, the recommended intake for vitamins may be insufficient for longevity
- › Bruce Ames' "triage theory" postulates that when a cell becomes short on a vitamin, it starts to ration it, favoring protein enzymes essential for immediate survival and reproduction over those that help prevent long-term diseases such as cancer and heart disease
- › Other nutrients that appear particularly important for longevity include ergothioneine, an amino acid primarily produced in mushrooms, NAC, NAD, carotenoids, choline, acetyl L-carnitine, alpha lipoic acid and taurine
- › Getting the right ratio of omega-6 to omega-3 fats is also important for optimal health, especially heart and brain health. The ideal ratio of omega-3 to omega-6 fats ranges from 1-to-1 to 1-to-5

***Editor's Note: This article is a reprint. It was originally published December 23, 2018.***

In this interview, Bruce Ames, Ph.D., Professor Emeritus of biochemistry and molecular biology at the University of California Berkeley, currently senior scientist at the Children's Hospital Oakland Research Institute, discusses the importance of vitamins and minerals for longevity and explains his "triage theory" of nutrients.

Ames was born two weeks after my dad, who passed away earlier this year, so he is 90 years old. He developed the famous and widely used Ames test, which tests the mutagenicity of compounds. In recent years, he's shifted from his work in mutagenicity to focusing on nutrition for healthy aging. He recently published a paper<sup>1</sup> in Proceedings of the National Academy of Sciences (PNAS) on this topic.

## **Disease Prevention Not the Same as Longevity Optimization**

In that paper, he proposes the recommended level of many vitamins may be insufficient for longevity. In other words, the levels required to diminish disease may not be the same as the levels required to optimize longevity. Ames explains:

*"In 2006, I was getting interested in vitamins. I worked on mitochondria, which are the organelles in the cell that make all your adenosine triphosphate (ATP), the high-energy molecule that drives your metabolism. But one of the side effects is it bleeds out oxidants. Oxidants are mutagenic. They can damage DNA.*

*They can damage protein and other molecules, just like radiation. Some of the same oxidants that come from radiation also come from your own aging mitochondria. It decays with age. Anyway, I was thinking, 'If vitamin C and vitamin E do all those good things, I wonder about the other vitamins.'*

*I started thinking about it, and it occurred to me that the body is becoming deficient in vitamins all the time, because people don't eat balanced diets. They fill themselves up with sugary soft drinks and empty carbohydrates, which don't have any vitamins.*

*You need 30 different vitamins and minerals ... Your body cannot make minerals. You have to get them from your diet. The same thing with vitamins."*

In 2006, he published a purely theoretical paper<sup>2</sup> in which he postulated that when a cell becomes short on a vitamin, it starts to ration it, favoring protein enzymes essential for

immediate survival over those that help prevent long-term diseases such as cancer and heart disease.

Each vitamin is found in many proteins. Zinc, for example, is in 2,000 proteins; magnesium is in 300. Biotin, which is in the fewest number of proteins, is in only five. Now, from the time that this nutrient rationing starts occurring, it could be a decade or more before cancer or heart disease (or other chronic ailment) actually develops.

*"So, what you're doing is trading long-term health for short-term health," Ames says. "You may look perfectly OK, but if you're not eating a good diet, you're aging yourself fast."*

## **The Ames Triage Theory**

He dubbed this nutrient rationing theory the triage theory,<sup>3</sup> from the battlefield term used by French doctors during World War I. Since they were short-staffed, wounded soldiers were divided into three groups: those who would survive without care; those who would die despite care; and those who might survive with care. The doctors treated the third group, where their time and energy could be of best use.

*"Dr. Joyce McCann, [Ph.D.] in my lab, who is a terrific scientist, said, 'Let's test this theory. Let's [review] the literature on one vitamin and one mineral' ... She picked vitamin K2, which is involved with 16 proteins, and selenium, a mineral that's only involved with 25 proteins. In nine months, she got a scientific paper<sup>4</sup> out showing that both of them have this triage system built in," Ames says.*

*"It's easy to explain for vitamin K2, because lots of vitamin K proteins are involved with blood clotting. Blood clotting is clearly essential for survival; otherwise you'd cut yourself and bleed to death. There are a whole handful of proteins that are vitamin K-dependent proteins that involve blood clotting. Those get [the vitamin K2] first. The same was shown for selenium.*

*The [proteins] that get starved are the ones that are preventing cancer or heart disease. My new paper<sup>5</sup> that just came out, 'Prolonging Healthy Aging:*

*Longevity Vitamins and Proteins,' shows that this is going to be a major factor in aging, because we're eating horrible diets."*

## **Many Are Deficient in Crucial Longevity Nutrients**

In his paper, he rank-orders the nutrients in terms of importance, many of which people tend to be deficient in, based on the estimated average requirement (EAR). For example:

- **Vitamin D** – 70% of people don't get enough based on the EAR
- **Vitamin E** – 60% of people don't get enough based on the EAR
- **Magnesium** – 45% of people don't get enough based on the EAR

That said, the EAR criterion is not an optimal amount, even for disease prevention, as it does not take long-term health into account. Evidence now suggests an ideal **vitamin D level**, for example, is between 60 and 80 nanograms per milliliter (ng/mL), which means probably 85% to 90% of the population are deficient.

Vitamin D is primarily obtained from sun exposure. It's called the sunshine vitamin because when ultraviolet (UV) light hits your skin, the cholesterol derivative is converted into active vitamin D. It's a really important steroid hormone that plays an important role in gene activation.

Ames himself admits taking "lots of vitamins," but has also eaten a healthy natural diet most of his life. Ideally, you'd get most of your vitamins and minerals from your diet. Magnesium, for example, is found in the center of the chlorophyll molecule, so leafy greens is a good source.

Similarly, folic acid comes from the Latin word "folia," which means leaf. "My mentor at the California Institute of Technology (Caltech) first isolated folic acid from 4 tons of spinach," he says, adding the clarification, "Folate just means the salt, and folic acid is the acid."

## **Omega-6 to Omega-3 Ratio Is Important for Healthy Aging**

Omega-6s and omega-3 fats are also crucial for healthy aging. As noted by Ames:

*"Omega-3s are very important in the brain. We need both of them. But our cooking oils are mostly omega-6s, and your body cares about the ratio. We're all deficient or mostly deficient, unless you eat a lot of fish, in omega-3s.*

*My former postdoc, Dr. Rhonda Patrick, [Ph.D.], recently published a beautiful paper. The genetic causes of Alzheimer's disease is a gene called Apolipoprotein E4 (ApoE4). If you have that one copy of that gene, you have three times the risk of Alzheimer's. If you have two copies, you have 15 times the risk.*

*If you have one copy and you get a concussion, then you're going to get Alzheimer's. It's really important. She worked out the mechanism, [showing] it has to do with transporting omega-3 into the brain as the fatty acid.*

*That blood-brain barrier deteriorates with age. By the time you get old like me – I was 90 [in December 2018] – the system for bringing that into the brain isn't working very well. She marshals the evidence that that's what's causing Alzheimer's."*

The ideal ratio of omega-3 to omega-6 fats ranges from 1-to-1 to 1-to-5, but the typical Western diet tends to be between 1-to-20 and 1-to-50. Most people, especially Americans, are guilty of this lopsided omega-3 to omega-6 ratio, and to correct it, you typically need to do two things:

1. Significantly decrease intake of damaged omega-6 by avoiding processed foods and foods cooked in vegetable oil at high temperatures. Common sources of harmful omega-6 to avoid include corn oil, canola oil, **soy oil**, hydrogenated or partially hydrogenated fats, margarine and shortening.
2. Increase your intake of animal-based omega-3 fats. Ideal sources include small fatty fish such as sardines, anchovies and herring, along with **wild-caught Alaskan salmon**, or a supplement such as krill oil.

## Other Important Longevity Nutrients

Aside from vitamins and minerals, Ames' paper also addresses a few other nutrients that appear particularly important for longevity, such as ergothioneine, an amino acid primarily produced in mushrooms, which he categorizes as "conditionally essential." He explains:

*"Some vitamins come from just a few sources. Ergothioneine is something that's not officially called a vitamin, although a few people have suggested it ought to be. It does some useful things in the body. It happens to come from fungi and mushrooms."*

Other valuable longevity supplements (not all of which are included in Ames' paper) are:

N-acetyl cysteine (NAC), a precursor needed for glutathione biosynthesis. Many of its benefits relate back to the fact that it helps boost production of glutathione, an important antioxidant your body produces naturally that helps reduce free radical damage and plays a role in the detoxification of heavy metals and other harmful substances.

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Nicotinamide adenine dinucleotide (NAD), a derivative of vitamin B3 (niacin), which is a very important coenzyme in metabolism. NAD sufficiency appears to be important for supplying an enzyme called poly ADP-ribose polymerase or PARP, which is believed to be one of the primary repair mechanisms for damaged DNA. Ames explains:

*"There are 50 enzymes cruising along your DNA looking for trouble. When they see a bump that shouldn't be there, they cut it out and fill it in. That helps repair the DNA. They all require magnesium, so magnesium's going to be important as well. It hasn't been [determined yet] but I suspect magnesium deficiency gives you more mutations."*

Taking enough niacin will help ensure you have a sufficiency of NAD coenzyme. However, while your body has a very effective salvage pathway that recycles most of

the NAD in your body, if you're abusing your body with exposures to electromagnetic fields and other forms of oxidative stress that cause DNA damage and depletes NAD through PARP consumption, then it may be wise to consider some type of augmentation program.

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Carotenoids such as zeaxanthin, lutein and astaxanthin.

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Choline, which is needed for detoxification of soluble toxins that we're exposed to on a regular basis. Even though your body makes some choline, it does not produce enough.

You can take it as a supplement, but it's typically sold in the form of a phospholipid, such as phosphatidylcholine. One of the primary sources of choline in the diet is egg yolks. Patrick, in her paper on omega-3s and Alzheimer's showed you can get omega-3s into the brain when it's attached to phosphatidylcholine.

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Acetyl-L-carnitine (not regular L-carnitine), which appears to be particularly beneficial for improving memory. Ideally, you need about 2,000 to 2,500 milligrams a day. Most notice a difference after a few weeks.

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Alpha lipoic acid, an antioxidant shown to improve mitochondrial health and inhibit Alzheimer's disease progression.

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## More Information

Ames is currently working on a paper called "Latitude Mismatch," in which he discusses the importance of vitamin D supplementation for people with dark skin, as they're not making enough vitamin D at northern latitudes.

*"We're trying to see whether that'll explain why African-Americans have higher rates of certain birth defects, as well as more cancer and more heart disease. I think vitamin D might explain it more," he says. "Vitamin D is turning on and off 2,700 genes. It's a hugely important substance ...*

*I point out in my paper that nutrients aren't drugs. If you do a clinical trial on a drug, nobody has it [in their body]. But if you do it with a nutrient, maybe half the population has it, and it washes out your studies, so they're all negative.*

*You have to measure it at the beginning and not test it on people who have enough. And then measure it at the end to make sure you gave enough to raise the levels to the right levels."*

To learn more about vitamins and minerals required for longevity, I highly recommend reading through Ames' paper,<sup>6</sup> "[Prolonging Healthy Aging: Longevity Vitamins and Proteins.](#)"

## Sources and References

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- [1, 5, 6 PNAS October 23, 2018; 115 \(43\) 10836-10844](#)
- [2 PNAS November 21, 2006; 103\(47\): 17589-17594 \(PDF\)](#)
- [3 Bruceames.org, Triage Theory \(PDF\)](#)
- [4 American Journal of Clinical Nutrition October 1, 2009; 90\(4\): 889-907](#)