Prolonging Healthy Aging: Longevity Vitamins and Proteins:
A Special Interview With Dr. Bruce Ames

By Dr. Joseph Mercola

JM: Dr. Joseph Mercola
BA: Dr. Bruce Ames

JM: Welcome, everyone. This is Dr. Mercola helping you take control of your health. Today we have the honor of having Dr. Bruce Ames. Many of you may have heard of him before, especially if you're involved in science, because he developed the famous Ames test, which is a system support, easily and cheaply testing the mutagenicity of compounds. It's widely used. He is currently professor of biochemistry and molecular biology emeritus at the University of California Berkeley. He's a senior scientist at the Children's Hospital Oakland Research Institute. Welcome and thank you for joining us today.

BA: It's a pleasure to be here.

JM: Likewise. You published many, many articles. But you've taken a shift in recent years from your work in mutagenicity and have really focused on prolonging healthy aging. You wrote an article on the Proceedings of the National Academy of Sciences (PNAS) – it was published in October – on longevity, vitamins and proteins. I'd like to discuss that with you now.

Because in that paper, you proposed that the optimal level of many vitamins – you discussed about 30 or so of the essential vitamins and minerals, and 11 others – the optimal levels for those vitamins may not be sufficient for longevity. The levels required to diminish disease may not be the same as to optimize longevity. Maybe if we could start there, and we could expand on that.

BA: Back 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 things, just like radiation. Radiation and some of the same substances come from your own mitochondria. It decays with age.

Anyway, I was thinking, "Gee, 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 such good diets. They fill themselves up with sugary soft drinks and empty carbohydrates, which don't have many vitamins. You need 30 different vitamins and minerals – magnesium, calcium, iron and zinc. You can't make a mineral. You have to get it from the diet. The same thing with vitamins.

Anyway, an idea popped into my head. I published a paper about it, purely theoretical, that when nature – each vitamin is in many proteins. Zinc is in 2,000 proteins. Magnesium is in 500 proteins. Some are only in 20. The least, biotin, is only in five. Anyway, there's this range of number of proteins. What I postulated is that when the cell became short of a vitamin, it did a rationing.

What it did is put it into those protein enzymes that are essential for survival, and it starved all the ones that are preventing you from getting cancer and heart disease or cancers accumulating mutations. Well, that takes a long time. The cancer doesn't show up until 10 or 15 years down the road. What you're doing is trading long-term health for short-term health. You may look perfectly okay, but if you're not eating a good diet, you're aging yourself fast.

JM: Okay.

BA: That was the idea that I call the triage, from the battlefield for the French doctors. There weren't enough doctors and lots of wounded journals came in in World War I 100 years ago. The doctors divided the soldiers into three groups: those who are going to get better anyway, those who are going to die anyway, and those where their medicine could help a little bit. They pick the third, where they can make a difference. Now, that was triage. I should call mine "biage," but the word "triage" is [inaudible 05:23], and it's come to have a wider meaning. I call this theory "triage."

JM: It's great.

BA: Dr. Joyce McCann, in my lab, who is a terrific scientist, said, "Let's test this. Let's look in the literature on two vitamins, one vitamin and one mineral. It's not truly complicated. You'd think you'd spend the rest of your life in the library." She picked vitamin K, which is involved with 16 proteins, and she picked selenium, a mineral that's only involved with 25 proteins. In 9 months, she got a scientific paper out showing that both of them have this triage system built in.

It's easy to explain for vitamin K. 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 it first. The ones that get starved are the ones that are preventing cancer or heart disease.

JM: And osteoporosis too.

BA: Yeah.

JM: I'm assuming you're referring to vitamin K2, as opposed to K1.

BA: Yeah.

JM: Okay. Great.

BA: My new paper that just came out, "Prolonging Healthy Aging: Longevity Vitamins and Proteins," what that shows is that this is going to be a major factor in aging. Because we're eating horrible diets. I have a list here of all the – I can't remember them all.

JM: You rank-ordered them in your paper. You listed vitamin D that 70 percent of the people are deficient. Which indexes or criteria are you using for sufficiency? Because some people believe it's probably 85 or 90 percent of people are deficient.

BA: The committees set up two numbers. RDA, which you all know about, recommended dietary amount. That's the number in your packages of potato chips or whatever you're buying. Estimated average requirement (EAR) is the primary number they come up with. That's where half the country is deficient in the vitamin and half has enough. That's called the estimated average requirement. That's the key number, because they set the RDA two standard deviations above that.

If you're below the EAR, you're in trouble. You're deficient officially. Well, 70 percent of the U.S. doesn't get enough vitamin D, based on this EAR number, 60 percent doesn't get vitamin E, and 45 percent doesn't get enough magnesium, and you go down the list.

Vitamin D, which I'm working on now, is not from your food. It's from the sun. It's called the sunshine vitamin, because the ultraviolet (UV) light in the sun in the skin will convert the cholesterol derivative to vitamin D. It's a really important steroid hormone, the 2,700 sites in the genome, where vitamin D either turns on the gene or turns off the gene, that's coded in this sequence. You really don't want to be low in vitamin D. Seventy percent of the population, which is mostly white, is deficient.

JM: If I can interject here for a moment. If I can just simply interject for a slight clarification. Because you're citing the EAR as the criteria. But if you look at many of the epidemiological studies in review and you look at other sufficiency approaches, I believe the ranges would be the 60 to 80 nanograms per milliliter. By those standards, we were looking at probably somewhere from 85 to 90 percent of the population are deficient. It's even worse than you're citing.

[-----10:00-----]

BA: The EAR, the committees don't take into account these long-term stuff. They just think, "You get scurvy or you get beriberi and you die." But in any case, what nature wants you to do is reproduce. It selects that amount that'll keep you alive, so you can reproduce. If the cancer isn't recounted for 10 or 15 years, nature says, "To hell with it, because we want you to survive now." That's the tradeoff.

JM: Anyway –

BA: It's pretty depressing looking at the percentage of the U.S. that's deficient in this vitamin, that vitamin or that mineral. Plus, if they take long-term effects into account, I think it may be even a higher percentage.

JM: Yes, indeed. Not a vitamin or mineral, but you address somewhat in your paper is the essential fatty acids, which, like vitamins and minerals, we can't make. That's why they're called essentials.

BA: Those are very important.

JM: Yeah. What's your take on that?

BA: The omega-6s and the omega-3s. Omega means the double bond is near the end. Anyway, omega-3s are very important in the brain. We need both of them. But our cooking oils are mostly omega-6s. Body cares about the ratio. We're all deficient or mostly deficient, unless you eat a lot of fish, in omega-3s. Fish is a very good source of omega-3s.

My former postdoc, Dr. Rhonda Patrick, just had a beautiful paper showing that 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 that it has to do with transporting omega-3 fatty acids into the brain as the fatty acid.

That blood-brain barrier deteriorates with age. By the time you get old like me – I'll be 90 next month – 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. If you have two copies of the gene, it's 15 times the risk. Playing things like football, things where you're battering up and getting concussions often, they should screen out the people who have ApoE4, because they're really at risk of getting Alzheimer's. Anyway, that's another matter.

JM: Sure. Congratulations on your personal longevity. My dad was born two weeks before you, and he passed away earlier this year. It's very obvious you have very high mental acuity, so you're doing something right. I'm wondering if you personally applied your recommendations in the paper you just wrote.

BA: I married an Italian wife, who feeds me a wonderful Mediterranean diet. But I take lots of vitamins. Now, people in nutrition really don't like supplements so much. They say, "Eat a good varied diet."

JM: Sure.

BA: "Eat your greens." Magnesium's in the center of the chlorophyll. Nature's color-coded in green. Magnesium isn't green, of course. You eat a big plate of spinach, cole or kale, you get your magnesium. Also, 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.

JM: Wasn't it folate? Isn't folic acid the synthetic version?

BA: No. Folate just means the salt, and folic acid is the acid.

JM: Okay. I was confused. Sorry.

BA: Anyway, it's an important vitamin. It's in your greens. Greens have other good things. Fish, you should eat more fish and less meat. You don't have to be a fanatic about it or vegan. Fish is really healthy. The Japanese have the longest-lived large population in the world. There's a

scientific meeting in Okinawa, which is the longest-lived province in Japan. It's crawling with centenarians.

JM: Yeah. Yes, indeed. I have some specific questions about some of the vitamins. You mentioned some of them earlier – magnesium, calcium and vitamin K2, I'm assuming your vitamin A, vitamin C, zinc, B6 and folate.

I'm wondering what your position is on the phosphorylated versions of these vitamins, like riboflavin or vitamin B6, pyridoxine. Do you feel that there's any benefit? The reason I ask is, just from a molecular biological perspective, the phosphorylated forms have a charge on them. Even though that's what the body uses, ultimately it has to phosphorylate it to make it bioactive. But if it's phosphorylated before it gets into the cell, is that a problem? Because it has a charge and it can't penetrate the cell membrane easily.

BA: The transport systems are designed to recognize the unphosphorylated form and bring it in. We'll do some splitting of the phosphorylated form, so it's slowly absorbed. But that form itself isn't absorbed very well.

JM: Alright. So you don't take any phosphorylated version? Do you ever think there's a need for them? Just from a science perspective, it makes no sense. Even though it's pretty widely promoted in many nutritional circles to take the phosphorylated ones.

BA: People in nutrition really look down on supplements a bit. But it's so complicated, the 30 vitamins and minerals you need. I just proposed another 11 of them, and there are more to be discovered. I think in 10 years, you're going to be sticking your finger in a machine and you get a fingerprint of blood. That machine will analyze everything and tell you, "Oh, you're low in magnesium. Eat some greens," or, "You're low in something else, eat that, or take a pill." There are a lot of pills as insurance.

JM: Yes, indeed. That's a wise strategy.

BA: I'm not saying that's why I'm 90, but I've eaten a good diet all my life.

JM: Okay. There's an interesting amino acid that you discussed in your paper that we've talked about in our site, which is ergothioneine, primarily produced in mushrooms. I believe you would categorize it as conditionally essential. Can you describe that in more detail?

BA: Yeah. 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. I reckon the first one. And it does some useful things in the body. It happens to come from fungi and mushrooms. That's about what I want to say.

JM: Okay. Do you take ergothioneine regularly?

BA: No. But I eat mushrooms.

JM: Okay. You eat mushrooms. You're taking it by the food source, which is pretty much the ideal. I tried looking that up on Amazon to see if someone was producing ergothioneine supplements, but they don't. You can get them, but they're just essentially mushroom extracts, which is great.

BA: Yup.

JM: And then there are – You don't really discuss this in your paper. But I'm wondering what your thoughts are in glycine and NAC or N-acetyl cysteine? Because of the importance of glutathione is an essential antioxidant, an intercellular antioxidant in the body. To address some of the ravages of oxidative stress.

BA: The key amino acid in glutathione is cysteine, which is a sulfur-containing amino acid, and it's a relatively uncommon amino acid and protein. All proteins have a bit, but they may have one molecule or two molecules. Anyway, that's important because we need that for all sorts of things. The body converts that to taurine, which decarboxylates the cystathionine. It oxidizes the sulfhydryl to sulfonic acid.

[-----20:00-----]

It's a very strong acid that cross from the amino group. That compound has a lot of literature saying it's really good for you. There's a gram of it per kilo of body. There's a lot of it in the body. But we don't seem to quite be able to make enough in some people, particularly if they're low in cysteine. I say maybe we should call that a vitamin too.

JM: Sure. Do you just recommend or prefer cysteine or the acetyl version of cysteine, which is NAC?

BA: I take N-acetyl cysteine, which people sell.

JM: Okay.

BA: You could take taurine, which is available as a supplement too.

JM: But I thought you said the cysteine converts to taurine. Does it do the reverse? Does taurine convert to cysteine?

BA: No, no.

JM: Okay. I didn't think so. If you're sufficient in cysteine, does that mean that you don't need a taurine supplement?

BA: Yeah. If your metabolism is all okay.

JM: Okay. That's what I thought, because you talked about taurine in your papers.

BA: There are a lot of polymorphisms which are ultimate forms of the gene that have been selected in the population, just the way ApoE4, a quarter of the population has it. Maybe it helps your mind when you're young or whatever. No one quite knows why. But Rhonda Patrick, who was a former student of mine has a blog where you can [upload] your 23AndMe results on that. Any nutritional polymorphism that people have figured out, we can change your diet to improve the symptoms. She'll tell you what that is and what to do. There's so many that have been worked out.

JM: Yeah. That's a great start, but that still only gives you a potential, just because you have the snip, doesn't necessarily mean you're going to have a problem. But what I've learned is that to look at the metabolomics. If you do something like a urine organic acid test, and you can see your specific snips and metabolisms are doing with those, then you can get a clearer picture of what's going on and really, I think, more accurate precise recommendations.

BA: Yeah. It is kind of – A lot of the genetic changes are due to nutrition, because we need so many things, like just the way skin color has to do with latitude. You can have a latitude mismatch. If you have dark skin, it's harder for you to make vitamin D. If you have a light skin and you move near an equator, you're going to get fried.

A lot of Irish move to Australia and we don't have to tell them, because the first time they go out, they get sunburned and they don't like it, so they wear a hat and cover themselves with sunscreen. But in the tropics, it's adjusted so you can make enough vitamin D and then their skin is dark enough to filter out the rest. That's all done automatically. You don't have to worry about it. Light skin is needed up north because they have so little vitamin D.

JM: Yeah. There's just less of a filter for the ultraviolet B (UVB). But in addition, as you wisely mentioned, we need the ideal as not to be swallowing oral vitamin D every day. It's just to expose as much of your skin as sensibly possible to the sun at the right time of year. I personally have not taken any oral vitamin D for 10 years. My vitamin D levels are in the optimum range. It's because I have sun exposure. But in addition to the UVB, you get ultraviolet A (UVA). UVA makes nitric oxide in your body through an interesting mechanism. And then also, you have the near-infrared, which can catalyze mitochondrial function and make the production of ATP more efficient.

BA: Yeah. I won't argue with you on that.

JM: Yeah. Okay. One of my passions now are these phytochemicals. You note it in your paper that there are over 8,000 different flavonoids, which is incredible. There's a lot of interest in these polyphenols and what they can offer for human health. But you don't seem to be too enthusiastic about them, and certainly you don't classify them as vitamins. I'm wondering if you can share your perspective with them, because they offer a lot of benefits, things like sulforaphane and some of these other –

BA: I wrote a paper about that. Every plant has to make pesticides. These are nature's pesticides. Each plant has 50 or 100 toxic chemicals to kill beetles that are eating it, and to kill you if you're the main predator. Some of those are harmful, and some might do some good to people. But it's very complicated. I tend to steer away from fields that are so complicated. I thought vitamins and minerals are some easier fields to sort out.

JM: Okay. So that's the approach. Now the mystery is revealed. Because of the enormous complexity of it, you chose to let alone. I would tend to disagree with that, because I've been diving deep into the literature. You know, most of the research has it down. We're just at the tip of the iceberg.

BA: Yeah.

JM: Eight thousand different flavonoids and they've only done research on a relatively small minority of that. Who knows what the interactions and complications are? That's why you avoided and just restricted it to the more well-studied vitamins and minerals.

BA: Being a good scientist is to know what problems are solvable. You're going to get mired in complexity and never get out.

JM: Yeah. Well, that's some sage advice. You've certainly been doing this for a while. When did you publish your first paper?

BA: I graduated [from] Cornell University with a Bachelor's in 1950, and went to Caltech for graduate school. That's how I entered genetics. I majored in biochemistry, so I took all the genetics courses. That time, biochemical genetics was just getting going, and I was interested in that. Caltech was the center.

JM: Okay.

BA: And then I got my Ph.D. in 1953, three years later. My thesis went really fast. I was lucky. I left at age 24 with my Ph.D. and went to the National Institutes of Health (NIH). I stayed there for 15 years. Somehow, I got in. In 1967, it was a great place to work. In 1967, I got an offer from Berkeley to come as a full professor. I liked California from my Caltech days.

JM: Sure.

BA: I packed up my family and kids and went off to Berkeley. I just retired in 2000, but I was bored stiff retiring, and I still have lots of big ideas, so I moved to the Children's Hospital Oakland. Now it's merged with University of California San Francisco (UCSF), so it's called the UCSF Benioff Children's Hospital Oakland. Anyway, there's one in San Francisco and our own out in Oakland.

JM: Interesting. Nowadays, Caltech has a reputation for being the epicenter of engineering. It didn't have much of a reputation back in the '50s, or it was more –

BA: No. It was always known as a good place. But it was small, and so they had to focus on a few fields.

JM: Okay.

BA: But they had first-rate geneticists.

JM: When did you do your work on the mutagenicity test?

BA: I started that when I was in the NIH, and then in Berkeley, I had a lot of undergraduates who wanted to work in the lab. I had them work on that.

JM: I'm wondering, with your interest in nutrition, if you've looked at nicotinamide adenine dinucleotide (NAD), which is a derivative of vitamin B3 or niacin. I mean it has niacin right in the middle.

BA: It's a very important coenzyme in the metabolism.

JM: Are you doing anything special? Because NAD sufficiency appears to be important for supplying an enzyme called PARP, which is poly (ADP-ribose) polymerase, which is believed to be – correct me if I'm wrong – but my understanding from literature is it's believed to be one of the primary repair mechanisms for damaged DNA, which you talked about earlier.

BA: 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. Forty-five percent of the population is low in magnesium. It hasn't been worked out but I suspect that magnesium deficiency gives you more mutations.

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JM: What about the niacin to make sure that you're taking enough? So that you can have a sufficiency of NAD coenzyme?

BA: That's been known.

JM: Because we have about 9 grams in our body. Fortunately, we have a very effective salvage pathway, which recycles most of it. But still, if you're abusing your body, especially with these exposures to electromagnetic fields (EMF) and other forms of oxidative stress, which causes the DNA damage and causes depletion of NAD through PARP consumption, then it may be wise to consider some type of augmentation program.

BA: Well, fortification is something the government uses. They fortified milk and orange juice with a little vitamin D, but it's not nearly enough, particularly if you have a dark skin. I think all dark-skinned people should take some vitamin D.

JM: Yeah. No question.

BA: They're not getting enough UV to make the vitamin D.

JM: How about the B3 for the DNA repair we were talking about?

BA: Yeah. All these vitamins, we need enough. There are lots of them. As I said, [there are] 30 known ones now vitamins and essential minerals. I've proposed another 11. I'm sure there are more to be discovered. It is complicated, but that's why industry's going to develop tools, so that we can analyze your blood cheaply and tune you up.

JM: Okay. You mentioned –

BA: Fortification – I got off the track. Fortification is useful. A number of vitamins are fortified in milk or in other things. That's a good thing. But the government is a monopoly and tends to be [inaudible 32:01]. They don't get updated often enough to get [inaudible 32:12].

JM: Okay. Now, you mentioned in your paper the importance of carotenoids, things like zeaxanthin, lutein and, actually, astaxanthin. I'm wondering if you have a sufficiency of astaxanthin or you're supplementing that with high amounts – Typically it's only found in seafood. It's an algae derivative. It's unusually enough seafood to have a few milligrams in your diet. But do you think that sufficient levels of astaxanthin would be enough to compensate for some of the carotenoid deficiencies?

BA: That isn't known, really. There are good people working on carotenoids. But people don't think of them as vitamins. So in the back of your eye, you have a little yellow spot, which has lutein and zeaxanthin, which are two different carotenoids. And then carotenoids are split to make vitamin A, if they have the right structure.

Anyway, it's an interesting field. And there are about six or seven of them in human blood, in reasonable amounts. Those are presumably the ones we need. But another one might be able to substitute for it. We don't understand all the mystery. Astaxanthin, the Japanese get lots of that with their diet of a lot of fish and seafood, they would have astaxanthin. But we don't eat much fish here. We don't have measurable levels in that one.

JM: Unless you supplement.

BA: You could supplement. Yeah. Now, with the astaxanthin will displace some of the other ones, or if you eat a good varied diet, you have enough of all the carotenoids.

JM: Okay. So you also talk about choline. From my perspective, I think you downplayed it, because it's more important than you imply in your paper. Because it's so crucial for detoxification of all these soluble toxins that we're exposed to on a regular basis. I'm wondering if you could discuss that for a moment.

BA: I'm not an expert on choline. But it has been proposed to be a vitamin. I think they've added it to the list.

JM: Yeah.

BA: Even though we can make some, we don't make enough. That's a class of vitamins that may turn out to be common.

JM: Yeah. It's usually choline – You can take it as a supplement, but it's typically in the form of a phospholipid. The primary one would be phosphatidylcholine. One of the primary sources of that in the normal diet would be simply egg yolks. Not egg whites, egg yolks.

BA: Rhonda, in her paper on Alzheimer's, showed that you can get omega-3s into the brain when it's attached to phosphatidylcholine.

JM: Yes.

BA: There's a transport system for that. Fish oil doesn't work.

JM: But krill would?

BA: Omega-3 attached to phosphatidylcholine goes in like a shock.

JM: Yeah. Which is twice as good.

BA: Krill works. And fish eggs, that's the main thing.

JM: Same thing.

BA: Fish eggs as expensive. That's salmon eggs and herring eggs.

JM: Sure. Yeah, yeah. I want to thank you for inspiring Rhonda to educate people about that because essentially, because of her massive education, it's essential. I haven't had fish oil for almost a year because she has exhausted the supply from one of the few vendors out there.

But nevertheless, I think you were able to replicate that, many of the benefits, as you mentioned, from krill. I take about 10 krill oil a day, because it has a relatively smaller amount of EPA and DHA. But half of that capsule is a phospholipid. And as you mentioned, I mean you're going to get far better penetration, even into the brain, which is really hard to get those omega-3s into. It's just a magnificent transport mechanism.

BA: She shows all of that in her new paper. Yeah.

JM: Yeah. I'm going to have to interview her for that new paper.

BA: She's really good. She has a blog where she interviews scientists.

JM: Yeah. I know. FoundMyFitness. It's a good one.

BA: It's called FoundMyFitness.com.

JM: Right. Yeah. It's great. Thanks for helping catalyze her magnificent contribution to the field and educating us about this.

BA: I was disappointed she didn't go into research science, because she's so good. But she performs a very useful purpose.

JM: Yeah. Education is powerful.

BA: Education.

JM: Yes. We need these translators, people who've been in the lab, have the technical skillsets and can understand the science from a technical perspective, and then translate it for those who haven't had that training.

BA: It's FoundMyFitness.com.

JM: Right. Do you have any new projects on your plate now? Are there any new exciting theories that you want to elaborate on and do a little research?

BA: I'm working on a paper with a friend called "Latitude Mismatch."

JM: Vitamin D.

BA: Vitamin D. Why dark-skinned people ought to pop a vitamin D pill. They're cheap. It's only a few pennies for tiny pills. Because they're not making enough vitamin D.

JM: Yeah.

BA: 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.

JM: There's no question. It's actually been known for some time. I've been teaching people that for the last 20 years. Because the epidemiological evidence is quite profound. Interestingly, vitamin D is the least expensive supplement on the market, at least on the cost of raw materials perspective. But is seafood cheaper? If you get it from the sun, it's free.

BA: Yeah. If you play tennis every morning with your shirt off, you're probably okay.

JM: Yeah, yeah.

BA: Even in a Northern climate. But we're pretty fine North in the United States.

JM: Yeah. You're up near San Francisco. It's kind of hard. You're not getting a significant portion of it in the year. Southern California, you'll get more. Or if you're in the mountains, unless you're in the mountains of San Francisco, because elevation will also help. Because you could be pretty far north. But if you're at 8,000 feet or 10,000 feet, then you have less atmosphere to filter out the

UVB, so you're getting quite a bit. You can even get it most of the winter if you're high enough up.

BA: Skin color around the world is all latitude. That's what it's all about. The two factors: getting burnt by the UV light and making vitamin D.

JM: Yeah. It's also really useful for suppressing autoimmune diseases. There's a powerful correlation between latitude that you mentioned and these autoimmune diseases, like multiple sclerosis. There's almost epidemics of that in Canada, in Northern Canada or the U.S.

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BA: I point out in my paper that nutrients aren't drugs. If you do a clinical trial on a drug, nobody has it. 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.

Over the years, the right level has been creeping up a little bit. It used to be 20, and then it became 30. Now, it's probably going to end up around 50. But every day the 10 new value –

JM: You're talking about the levels of vitamin D as considered sufficient?

BA: Pardon?

JM: You're referring to the sufficiency levels of vitamin D?

BA: Yeah.

JM: In nanograms per milliliter.

BA: Yeah. Nanograms per millimiter.

JM: Yeah. You are right. Last century, before 2000, it was 20. That was only to prevent rickets. They didn't understand or appreciate the other benefits of vitamin D in heart disease and cancer.

BA: And it's known to be involved with bone development. That was what rickets was about.

JM: Yeah. That confused me for a long time.

BA: That's why African-Americans had stronger bones than whites, and yet they're much more deficient in vitamin D. That confused everybody. They thought, "Well, maybe they don't need vitamin D." Well, it turns out they probably do. As I say, vitamin D is turning on and off 2,700 genes. It's a hugely important substance.

JM: Yeah.

BA: Every day there are new diseases that it's being linked.

JM: Well, ultimately, you know, my conclusion is that vitamin D is a marker. It's a marker for healthy exposure to the sun, which is the way you're supposed to get it. If you have healthy vitamin D levels and you're getting other benefits from the sun, it's impossible to get it from swallowing a vitamin D pill. If you don't have access to the sun for whatever reason – and there are many – then there's the lesser of two evils. Just swallow the vitamin D pill. But ideally, you want to get it from the sun and never get burned.

BA: I won't argue with that. That's why epidemiology is so complicated.

JM: Yes. Absolutely.

BA: Epidemiologists joke is, "Miami's a weird place. Everybody's born Hispanic and dies Jewish." The Jews from New York moved down to Florida, and the Hispanics are having lots of children.

JM: Yes, indeed. Alright. Looks like you're busy there with all your research. Your table is full of papers that you're reading, which is terrific to see that you're still active and engaged in a learning process.

BA: I do. I'm forgetting lots of things. At 90, one isn't shocked with this.

JM: You know, let me recommend a nutrient for you for forgetfulness. I just came back from a conference two days ago and there was a whole lecture on how to improve your memory. One of the nutrients – maybe you've looked at this, I don't know – is acetyl-L-carnitine, which seems to be – not regular L-carnitine, but acetyl-L-carnitine. But you need enough. You need like 2,000 to 2,500 milligrams per day. It doesn't work like in a day or two. It takes a few weeks before you notice the difference.

BA: I published a paper on acetyl-L-carnitine and lipoic acid in improving mitochondrial health.

JM: Absolutely. But it may help memory function too.

BA: Well, I hope so.

JM: Are you taking that at all?

BA: I take carnitine and lipoic acid, yes. I take lots of vitamins as sort of an insurance.

JM: Sure. Maybe you want to add acetyl-L-carnitine, like 200 grams a day and see what happens with that memory function.

BA: I don't take that much.

JM: But you might want to add it. Look it up in the research. There are some pretty compelling research. Mostly the Italians are doing it. Interesting studies on that though. Alright. Anything else you'd like to add today, Dr. Ames?

BA: No. I'm having fun doing my science, but it does take longer when you're old.

JM: Yes, indeed. Alright. Thank you so much. I appreciate all your time today.

[END]