Dr. Mercola: I'll bet you'd like to know what I believe is the most exciting and profoundly effective antioxidant. Hi, this is Dr. Mercola, helping you take control of your health. Today I am joined Tyler W. LeBaron. W is important because there's a number of Tyler LeBarons out there. He is a literally world-class expert in molecular hydrogen. He did his initial training out in Nagoya University, did his internship out there, obviously in Japan, where most of all his research was done.

The reason why you probably haven't heard of it is because it's relatively new. The landmark papers only came out 10 years ago. Most of the science is in Japan, as I said, so it's relatively new, but you are going to be fascinated with the information that Tyler has to share today. Welcome, and thank you for joining us today, Tyler.

Tyler LeBaron: Well, thank you for having me. I'm glad to share the research in molecular hydrogen.

Dr. Mercola: Yes, and now, what I neglected to mention is that also you are associated with the Molecular Hydrogen-

Tyler LeBaron: Molecular Hydrogen-

Dr. Mercola: ... Foundation.

Tyler LeBaron: ... and Institute, yes. We're a science-based non-profit. We don't sell or represent any products, but our mission, our focus, is to advance the research and the education and the awareness of hydrogen as a therapeutic medical gas. That's what we need, that's what we're interested, that's what we do at our organization.

Dr. Mercola: What is your position there?

Tyler LeBaron: I'm the executive director. I'm also director of several other non-profit organizations, such as the International Hydrogen Standards Association, where we're working to actually create the standards for the ISO criteria for measurement of hydrogen gas. Even in all of the scientific research for marine biology or other areas for measuring hydrogen, there's actually no official standards. We're looking to make the actual standards, as well as those for hydrogen products so that consumers can know what could be considered as therapeutic type product or not. I'm also director for the International Molecular Hydrogen Association, and I'm also involved with the International Society of Medical Hydrogen Research and Biology.

Dr. Mercola: All right, so you're at the leading forefront of all these organizations, but let's get into the depths now, and explain what hydrogen is. Well, before we start that, might we explain what it's not, because there's a lot of confusion about

hydrogen with respect to it being hydrogen ions, or pH, so let's clear up that first and then we'll expand on the hydrogen, what its benefits are.

Tyler LeBaron: Yeah, absolutely. First, when we talk about molecular hydrogen, it's just diatomic hydrogen, H2 gas. It has nothing to do with-

Dr. Mercola: Two hydrogen atoms.

Tyler LeBaron: Correct.

Dr. Mercola: Combined-

Tyler LeBaron: Combined together.

Dr. Mercola: ... which is the smallest molecule in the universe.

Tyler LeBaron: Smaller than oxygen.

Dr. Mercola: Yes. Oh, by loads.

Tyler LeBaron: That's why it's so bio-availability. It's very small. It's neutral, so it's not an ion. It has nothing to do with pH for example, will not change the pH of water, the pH of your body, so it's nothing to do with the acclaimed alkaline concept, if you will. It's just hydrogen gas. It's three times more energy-dense than gasoline. That's why it's being looked at as an alternative energy source or fuel.

It's what powers the sun and fusion in producing helium. This is the hydrogen we're talking about and we're seeing it can also be therapeutic, effective, whether you inhale it, dissolve it in water and drink it, or other methods of its application.

Dr. Mercola: Okay, how did you first become aware of this and start your journey in becoming a world-class expert in this area?

Tyler LeBaron: Well, with the hydrogen gas it was in 2009, and I came across an article published in Nature Medicine. This was significant because Nature Medicine is one of the more reputable or prestigious scientific journals. This article showed that hydrogen was effective at preventing the brain damage from ischemia reperfusion induced by a middle cerebral artery occlusion in a nano model, so it cut the blood supply to the brain and that caused brain damage, but inhalation of only 2% hydrogen gas, which is below the fungibility level, was effective at suppressing the brain damage and had great effects in the model.

When I came across this article, I thought, "This is really interesting." This was a long time ago, and I wasn't an expert, and I'm not an expert by any means. It's so much more to learn. I didn't have a strong understanding of biochemistry, but there was something that hit me when I read that article, that I needed to

look into this. This is my future. This is what I needed to do. I took it from there and was able to read all the research, all the literature, and continue advancing in this area, then later as you mentioned, go to Japan.

Now I'm able to work with and collaborate with some of the top researchers around the world in this. I feel very fortunate to be involved in this emerging area of hydrogen gas.

Dr. Mercola: What's sparked your interest in that? Did you have a degree in chemistry at the time?

Tyler LeBaron: Yeah, well, I was actually getting my degree in biochemistry at the time, but I've always been interested in health, in wellness, in exercise performance, all of these things. My whole life I've always loved that. Then I came across this, something that's safe, something that's natural, something that's easy to use, and could be rather scientific. It fit every category that I've interested in since a very young age. I mean, we're talking elementary school, when I started reading and looking into this stuff just out of curiosity. It hit on all cylinders. A small molecule is a very big molecule in my life.

Dr. Mercola: Yes, indeed. You mentioned your passion about health and exercise, as I certainly was and continue to be, but you're a shining example of applying this information and getting pretty significant benefits. You're modest, so I'm just going to say right now that you may not look like it, I mean, you look healthy, but you not be aware of Tyler's capacity as an athlete, and that you've run a 2:30 marathon, which would, in years past, qualify you for the Olympic trials. Your new goal is to actually run a 2:20, which will qualify for the Olympics trials now, right?

Tyler LeBaron: Yeah, well 2:18 and up to a 10, that's a lot of time to cut off, 10 minutes. I mean, I ran a 5:45 average mile pace and trying to cut off another 30 seconds per mile. It may be quite difficult, but it's fun to have goals to shoot for.

Dr. Mercola: Yeah, not only that, because there's a lot of people that run that fast as a marathon, but to balance it out with strength training. I was a long-distance endurance athlete for 40 years and regret that, mostly because I didn't integrate strength training into it, but you're doing strength training.

Tyler LeBaron: Yeah, I do.

Dr. Mercola: What have you dead-lifted, which is probably one of the premier strength-training tests?

Tyler LeBaron: Well, I mean, on the straight bar, 420 is my max, a little bit more on the hex bar.

Dr. Mercola: Hex bars are a little bit ... they're easier. I prefer the hex bar rather than-

Tyler LeBaron: Yeah, for me they're a little easier because I have really long legs and a short torso, so I can get under there a little bit better, but in competition you have to use a straight bar, so I try to focus more on a straight bar.

Dr. Mercola: Sorry for the little tangent, but Tyler is an athletic stud and part of his reason for pursuing this area was his interest in athletics. Well, before we go into the application athletics, because they're profound applications-

Tyler LeBaron: Yeah, I'm excited to talk about that.

Dr. Mercola: ... I want to go into the mechanism of how it works, because essentially it lowers oxidative stress, which is really, along with inflammation, and inflammation causes oxidative stress-

Tyler LeBaron: And vice versa, right?

Dr. Mercola: Yeah, so they're two of the most fundamental mechanisms for destroying human health. That's why this is so exciting, is that this molecular hydrogen is probably the best antioxidant out there, for a variety of reasons. This is not hyperbole. You'll come to the conclusion after we share this information [inaudible 00:08:45] you'll reach a similar conclusion, I think. Why don't we talk about the mechanism, because there's some confusion.

You would think that the hydrogen gas dissociates, knocks off, or is able to neutralize hydroxyl free radicals, which is probably the premier worst free radical that you could have and causes the most oxidative damage, but it doesn't appear to work that way. Why don't you get us up to speed as to what the current thinking is and the mechanism.

Tyler LeBaron: Sure, and I appreciate that you talked about the inflammation oxidative stress as the underlying cause to virtually every disease. I'm going to get to your question, but this is an important thing to consider, because it is almost a skeptical sign, if you will, when we look at a molecule like hydrogen that has such a wide diverse effect in so many different diseases. So far, the research is still in its infancy. We don't have decades of clinical studies for hundreds of-

Dr. Mercola: Yeah, and that landmark paper that you read in 2009, was actually published in 2007.

Tyler LeBaron: In 2007, yeah.

Dr. Mercola: 10 years ago.

Tyler LeBaron: Exactly, right, so this is still quite new. There's over 1,000 publications on molecular hydrogen and they're suggesting that hydrogen has a therapeutic potential in over 170 different human and animal diseases. The reason why it can be so many different diseases, because most drugs it's one disease, one

organ, one target. Hydrogen, many organs, many targets. In fact, hydrogen is shown to be effective in essentially every organ of the human body, which we'll talk about.

The reason why is because it really helps to mitigate the area of oxidative stress and inflammation. Okay, how is it mitigating oxidative stress? You're right, this hydroxyl radical, it is one of the most cytotoxic radicals. I think in order to understand how hydrogen works, we need to understand a little bit how free radicals work and why they're produced anyway. First off, the hydroxyl radical, which is OH neutral with a lone pair electron, it's produced in the body through the Fenton reaction.

When you have different free radicals that get too high, like superoxide radicals, or high levels of perioxynitrite, that can be converted into hydroxyl radicals, ionizing radiation, these can all be converted to hydroxyl radicals, and they are so damaging because they are so reactive. Wherever they're produced, they immediately react with-

Dr. Mercola: Let me just interject here, too, because most anyone wouldn't dispute the damage of ionizing radiation. The commonly held belief is that most of the damage occurs because of the high energy in those bonds in ionizing radiation to actually break the DNA and covalent bonds, but actually it's the production of the oxidative stress that probably causes more DNA double and single-stranded breaks than the actual ionizing radiation itself.

Tyler LeBaron: Yeah, that may be because now you're talking about propagation cascades, right? Now, you have a really serious problem. When you look at the other free radicals, nitric oxide, that's a very important free radical with basal dilation.

Dr. Mercola: Therapeutic.

Tyler LeBaron: Right, we don't want to neutralize that. We have superoxide radicals. We have other oxidants like hydrogen peroxide, these are all very important. Of course, too much is bad, but having them in the right concentrations, the right locations, is very good for you. We don't want to just neutralize all of those, whereas, like hydroxyl radicals, yeah, we don't want any of them, or perioxynitrite oxidants, we don't want any of that.

That Nature Medicine publication in 2007 specifically showed that hydrogen could act, notice that word, could act as a therapeutic antioxidant by selectively reducing the cytotoxic oxygen radicals, specifically the hydroxyl radical and to a lesser extent perioxynitrite, without decreasing the other oxidants like hydrogen peroxide or superoxide. In that sense it is selective, but how does it actually do that? Typically, when we think of that-

Dr. Mercola: Yeah, and that's the key word, selective, as you're going to hear. That is, if you have a key word here, it's selective, that differentiates it from essentially every other antioxidant.

Tyler LeBaron: Exactly. Most other antioxidants, they're not selective. They're just, "Hey, have an electron? Take it," and now it's going to neutralize that. That can be problematic. I think potentially when we look at some of the clinical trials on antioxidant supplementation in general, there's a lot of conjecture of, "Maybe that was a synthetic, or this was that," or whatever, but the fact is, these are still antioxidants in the conventional sense.

They took high levels of them and they had to stop the clinical studies, because the people taking the antioxidants were dying, getting cancer, lung cancer or prostate cancer, or cardiovascular disease faster than those on placebo. You see the same thing with sports athletes, that athletes taking antioxidants, high levels chronically, they negate the benefits of exercise training, but potentially because the antioxidants are neutralizing these beneficial signaling molecules that our body needs. Hydrogen is selective in that it's only going to decrease or reduce those toxic radicals like the hydroxyl radical, right?

Now the mechanism, how does it do it? Is it really that hydrogen gas is directly reacting with the hydroxyl radical, scavenging it, and producing water? It's possible it happens, I suppose. It can happen, at least in vitro, because the reaction is favorable if you calculate. It gives free energy, for example, but there's a lot of other competition with a lot of other antioxidants, and the rate constants are quite low for hydrogen gas. Probably the direct scavenging does not account for the therapeutic actions of hydrogen. There's two definitions of an antioxidant I'm going to give you.

Dr. Mercola: Let me just stop you there, before you get to the definitions. What you just stated actually contradicts with the earlier beliefs for them. People early in the field thought that was the mechanism.

Tyler LeBaron: Well, it's interesting. That may be more what people interpreted, what was the early beliefs, but if you look at the paper, hydrogen acts as a therapeutic antioxidant. It doesn't say it is. It says it acts as one, right? Also, the definition of an antioxidant, one of them on the conventional chemistry side could be a molecule that donates itself to a radical reaction, inducing a termination step, donated an electron, sacrificing itself or giving an electron. Then on the other side there is simply a molecule that improves the redox status of the cell.

Dr. Mercola: Okay, explain redox status, because many people will not even know what that is.

Tyler LeBaron: Okay, redox, as in oxidation reduction, there's a balance, right, not through its homeostasis area, but you have to have so much oxidation in the body, and so much reduction in the body. There's a balance between the two, life is

balanced. Just like a battery, you have a negative and you have a positive. You can't have just a negative electrode or a positive electrode, and the body is the same, the cells are the same. You have to have an oxidation and a reduction. That's how everything works, cell communication, everything.

When that balance gets perturbed, either too much oxidation, you have oxidative stress. If you have not enough, you have other serious problems. If you don't have enough oxidative power, for example, in your endoplasmic reticulum, which folds the proteins, you have misfolded proteins, which leads [awloss 00:16:30] of disease. Aging and diseases is really associated with a disregulation, a redox disregulation. It's not so much an excessive amount of free radicals, but a redox disregulation. That's the real issue with aging and diseases.

Dr. Mercola: That's a profound concept that really most people haven't been exposed to.

Tyler LeBaron: It's not, "Oh, free radicals." No, we need free radicals, and studies have shown you can actually suffer from too much oxidative stress and too much reductive stress, or not enough oxidative potential, not only in the same body or the same organ, but in the exact same cell. Too much oxidative stress in the cytosol, not enough oxidative power in endoplasmic reticulum. Hydrogen helps to bring everything back to homeostasis.

Going back to how hydrogen works, we see in cell studies, in animal studies, in plant studies, in human studies, and all of these studies, hydrogen does indeed exert an antioxidant-like effect. It acts as this antioxidant to improve the redox status of the cell. We see this through markers that MDA, malondialdehyde, OHdG, which is a marker of DNA damage. We see improvements in superoxide dismutase, glutathione levels.

I could just go on down the list of what we see in clinical studies and other animal studies, showing that indeed hydrogen does improve the redox status of the cell when it is needed. How does it do it? It's not done through this conventional radical scavenging activity. It does it through acting like an antioxidant, and does so by selectively ... Part of the reason is selective reducing just the cytotoxic radicals, again probably not directly reacting because of the competition with so many other nucleophilic endogenous electron donors in the cell.

How does it do this? Well, maybe it's helping to prevent some of the free radicals from being produced. For example, in one animal study, they took these mice and they chronically restrained them in a container so that it would induce a cognitive impairment, Alzheimer's basically. They did a genetic knockout for vitamin C depletion. Almost all mammals produce vitamin C-

Dr. Mercola: Except humans, right?

Tyler LeBaron: [crosstalk 00:18:52] I think guinea pigs, and I think bats also, but they did the genetic knockout so they would suffer from oxidative stress, and they found that the drinking of hydrogen-enriched water was very effective at preventing the development of actually atherosclerosis, but also in the production of superoxide in the hippocampus of the brain. When we see other studies with an allergic-type reaction, that hydrogen downregulates NOX system, NADpH oxidase, which is a complex that produces free radicals like superoxide radicals.

When they get hyperactivated and chronically stimulated, we have high levels of free radicals and subsequent inflammation that is very damaging to the cell and causes cell death, apoptosis. Hydrogen is able to downregulate, actually go in and down regulate this NADpH oxidase system in other ways to actually prevent these excessive free radicals from being produced in the first place. That's one way-

Dr. Mercola: That's a powerful mechanism.

Tyler LeBaron: Yeah, it's a prevention, right? What's better?

Dr. Mercola: The best way.

Tyler LeBaron: Exactly. That's one of the ways hydrogen can help mitigate and improve the redox status of the cell and thus act as this antioxidant, right? Another way, you're familiar with the Nrf2 pathway, the Nrf2 pathway, right?

Dr. Mercola: Absolutely.

Tyler LeBaron: This is a transcription factor that, when it's activated, it goes into the nucleus and binds to the DNA, where it binds to the ARE, the antioxidant response element. It then induces the transcription of further cytoprotective enzymes, your glutathione, superoxide dismutase catalase, glutathione peroxidase, phase II enzymes, heme-1 oxygenase, there's many, many cytoprotective enzymes. Hydrogen can somehow also activate the Nrf2 pathway. This is another reason why we're seeing in proof ...

One other study a few years ago in metabolic syndrome, they found that the subjects drinking hydrogen-enriched water had about a 43% increase in exocellular superoxide dismutase. Yes, hydrogen does have this antioxidant-like effect, because it can help regulate Nrf2 pathway and bring these levels of these enzymes and these cytoprotective proteins back to the levels they're supposed to be, back into that realm of homeostasis.

We see this through many clinical studies. That's another way that hydrogen gas can exert an antioxidant-like effect. It's more the cell modulation, the type action, but again as a direct radical scavenger, probably not so much [inaudible 00:21:45]

Dr. Mercola: Can you relate how effective hydrogen is at stimulating Nrf2 pathway relative to some of the other nutrients and phytonutrients that are known, like glucoraphanin or sulforaphane for the ... a whole variety of others. It's a really important pathway, and it's probably one of the most important ones, because it just produces the antioxidants when you need them. It's hermetically controlled, so it's not like a surge of [crosstalk 00:22:15] antioxidants.

Tyler LeBaron: Right, yeah, absolutely. It would be nice to be able to quantify.

Dr. Mercola: Yeah, but we don't know.

Tyler LeBaron: I don't know that we can do that, and because hydrogen is very mild, because if you take ... and you see this if you look at the studies. This is why hydrogen is so difficult to study, is because if you administer molecular hydrogen to a cell or an animal, a lot of times you don't see any changes. If everything is already perfect, everything is already in homeostasis, you don't see changes. You may see changes in gene expression and mRNA levels, but other significant changes, especially phenotypically, you don't see.

Perhaps if you are to give a drug or other pharmacological agent that's potent, you do see significant changes. You don't see that with hydrogen. For hydrogen, often you have to administer some sort of a toxin or an assault of some sort, and you look to see how hydrogen mitigated or rescued or attenuated those effects from that toxin-induced problem. If you were to give hydrogen to a cell or a human that's healthy, and you look at the Nrf2 activation or the glutathione levels, often you may actually see no change at all.

Dr. Mercola: If the cell's healthy.

Tyler LeBaron: If the cell's already healthy. As soon as you are to induce some sort of a toxin, radiation or some environmental pesticide-type toxin, which we see in some of these studies, that's when you start seeing that, "Oh, look, hydrogen helped prevent the downregulation or the decrease of that glutathione or that superoxide dismutase level in the cell." This is important because it's not good to have a constitutively active Nrf2 signaling. That's really bad.

Like I said, you have to have a balance, redox balance, redox homeostasis, it's not really a balance. It's redox homeostasis and if you have a constitutively active, activated Nrf2, there's genetic conditions where you can actually have too much of a reductive components that are being produced. That can lead to various ... myocardial hypertrophy in other areas. That's not good, and various toxins, cancer even, it can be problematic in that area. It is a little concerning.

Maybe some of these strong, powerful agents taken chronically over a long period of time, maybe they're not so good to be doing, because maybe some of your cells, let's say your liver, maybe they need some extra Nrf2 upregulation, but maybe the cells in your brain or something, maybe they don't need that.

Well, if you take this other component, just conjecture, but perhaps that other pharmacological, strong, signaling component would upregulate Nrf2 in many of the cells, even those that don't necessarily need it.

Dr. Mercola: Systemically with others.

Tyler LeBaron: Systemic.

Dr. Mercola: Without differentiation or discrimination.

Tyler LeBaron: Exactly, whereas with hydrogen, it knows.

Dr. Mercola: I've heard you lecture many times. There's a brilliant slide that you have in there. We can get in post-production, integrate it into this video and you can talk about it as if the slide was there.

Tyler LeBaron: Okay.

Dr. Mercola: It's the study where they showed basal levels of oxidative stress, and then they administered, I think [inaudible 00:25:31] ionizing [crosstalk 00:25:31]

Tyler LeBaron: Oh, sure, sure, yeah, with the-

Dr. Mercola: ... hydrogen with and without. It's like one picture is worth 1,000 words [crosstalk 00:25:39] it's beautiful.

Tyler LeBaron: Yeah, it was published in Free Radical Research, and it was just showing a marker of DNA damage, 8-OHdG. You'll see that, yes, there's very basic levels of oxidation, if you will, all the time. Then when you administer the molecular hydrogen to that healthy cell with no radiation, the level stays exactly the same.

Dr. Mercola: The meaning being, because the basal level of free radicals, which you need to stay healthy, doesn't get lowered.

Tyler LeBaron: Right, right, exactly, and then the ionizing radiation, yeah, goes really high up. Then you can see hydrogen significantly attenuates that upregulation of the oxidative stress.

Dr. Mercola: Yeah, I believe it was about 80% reduction. It was over 50%, I'm pretty sure.

Tyler LeBaron: Yeah, I have to go back and look at it, but it was significant, yeah.

Dr. Mercola: Significant, so what does that mean? It means that there are going to be times in your life when you are going to be exposed to ionizing radiation stress.

Tyler LeBaron: Or other toxins, right?

Dr. Mercola: Other toxins, but it wasn't [inaudible 00:26:42] ionizing radiation because we know that's what the study was done with. You're getting an X-ray, you're getting a CAT scan, you're flying at 35,000 feet and exposed to gamma rays. What are the implications for that? According to the study, if you have taken a therapeutic dose, and we'll talk about what that means in a moment, of hydrogen, you can radically lower the damage from ionizing radiation.

Tyler LeBaron: Yeah, I mean, we'd need a clinical study, but the implication, it's certainly something worthy of pursuing.

Dr. Mercola: That's what I use all the time.

Tyler LeBaron: Well, hydrogen is safe, hydrogen is safe, and so it's not a bad idea.

Dr. Mercola: Well, talk about its safety, and then just from a historical perspective why it might be considered beneficial, because we actually make hydrogen gas, or our gut bacteria makes the gas.

Tyler LeBaron: [crosstalk 00:27:40] Well, there's two areas that I find interesting. One of that is the fact that we're always exposed to hydrogen and this does show safety, but it also potentially shows a reason why hydrogen is therapeutic in the first place. It's a romantic story, when you consider hydrogen, number one on the periodic table of elements, right? Number one, first element, the Big Bang, however direction you want to take it, hydrogen is considered the father of all the elements.

It's what powers the sun, and then we have life created on Earth. Potentially it started in the deep sea hydrothermal vents. Hydrogen could have been used as the first energy source that started the genesis of life, and now we're seeing with the hydrogen hypothesis, with hydrogesomes and mitochondria, that hydrogen was actually the key that forged the bond of making eukaryotes, or plant and animal cells, out of bacteria.

Hydrogen was involved in the beginning of the universe, the genesis of life, the evolution of life, and now we have developed this symbiotic relationship with bacteria on our skin and our intestines, right?

Dr. Mercola: Our cells.

Tyler LeBaron: This is a huge thing, is the probiotic. Everything is there, but our intestinal bacteria produce hydrogen gas also, lots of hydrogen gas, liters, liters a day, up to 10 liters or more a day, depending on the individual.

Dr. Mercola: If you're Imperially-oriented like the United States, it would be two and a half gallons.

Tyler LeBaron: Okay.

Dr. Mercola: That's a lot.

Tyler LeBaron: It is a lot, but it's interesting just from an evolutionary perspective, the fact that we've always been exposed to hydrogen gas. Perhaps through evolution we've conserved some of the targets, or we've developed targets, and this is why we're seeing the therapeutic effects of exogenous hydrogen gas administered in the cells. We know that the hydrogen gas produced through intestinal bacteria is therapeutic.

We've seen, for example, one study from the University of Florida with the Forsyth Institute in Boston, they did a genetic knockout in E. coli and they found that the administration of the lactulose into animals, rats that had E. coli that can not produce hydrogen gas, they took out the hydrogenase enzyme, well, they would metabolize the lactulose, the non-digestible fiber, but there was no benefits to the fiber anymore.

They put the bacteria back in that could metabolize lactulose and produce hydrogen gas, this hepato-protective effects were reinstated, suggesting that at least in this condition, the benefits of the fiber were mediated by the production of hydrogen gas.

Dr. Mercola: Let me frame that, because a lot of people may not understand what you said, and given my clinical experience.

Tyler LeBaron: Please, yeah.

Dr. Mercola: Lactulose is a nondigestible sugar. You don't have enzymes in your body to break it down. These gut bacteria do. This is actually considered a drug. It's a prescription drug, and I used it when I was in residency training, for people with hepatic encephalopathy, and it believe it's still used, and it works. Now, how could a nondigestible sugar get people out of hepatic encephalopathy? It's brain damage as a result of liver failure. How did that work? It makes no sense, but it worked, and it was used and it's still being used. I never understood, I don't think most anyone out there understands how it works, until you shared this with me earlier.

Tyler LeBaron: That's interesting, yeah. Maybe these other ones, like [aycarbos 00:31:11] and things I've suggested [crosstalk 00:31:12] there some of the cardiovascular protective effects are mediated by the increased production of hydrogen gas. Then the question remains, well, then, if this hydrogen gas is so good for you and you're producing so much of it, why would ingestion of hydrogen-rich water, which is not near as much hydrogen gas as you'd do from the other method, why would that still be therapeutic?

Dr. Mercola: It's literally orders of magnitude lower, right?

Tyler LeBaron: Yeah, yeah, we're talking, if you consider the saturation about 18 milliliters of hydrogen gas, 0.8 millimolar or 1.6 milligrams per liter, yeah, it's not very much in comparison, but we still see in the animal and human studies-

Dr. Mercola: Plant.

Tyler LeBaron: Plant, yeah, which is very interesting, because all eukaryotes have this ubiquitous effect, but we still see it's very effective. In fact, in one of the studies actually at Nagoya university, in a Parkinson's disease model, they showed that a continuous administration of hydrogen in the air was not effective at preventing the Parkinson's disease, but in intermittent exposure was effective, but not near as effective as drinking hydrogen-rich water.

Dr. Mercola: Now that is key. You just encapsulated the treasure chest of how to understand hydrogen and get it to work. Expand on that point, because cyclical or intermittent exposure as opposed to continuous, you've got to understand that.

Tyler LeBaron: Yeah, again, we need more research to really understand the primary targets and molecular mechanisms of how it works, but it does appear to be more of a gaseous signal modulator. The way signal modulators work is, it needs to have this intermittent type exposure, or else you get habituation or subsequent attenuation of the signal. That's what we're seeing with hydrogen gas, and in fact, in that study I mentioned earlier with the polio protein E knockout mice ... That was vitamin C, so this one, polio protein E knockout mice who would develop atherosclerosis.

I think I got those two confused, but in this study, they originally tried inhalation of hydrogen gas. They saw good effects, and then they disappeared. Then they tried drinking hydrogen-rich water and the effect was significant during the entire study. It was more effective than other methods. It was a very powerful study, published in 2008, but again it was this idea, this intermittent type of exposure. I think this helps us to understand how hydrogen gas works is the inaudible 00:33:43] type effect, getting the hydrogen into the body, inducing the cell modulation of some sort, and then that's gone and that's going to alter the gene expression.

Dr. Mercola: Yeah, and I think it's related to some universal, biological phenomena that really requires this intermittent cycling, pulsing effect. I absolutely personally confirmed it, and believe this is true for diet. I wrote a book, Fat for Fuel, which talks about helping people get into ketosis because it's so therapeutically beneficial, but you can make the mistake like I did, to think if it's so good, let's do it continuously, just like if hydrogen is so good, let's do it continuously.

Well, the problem is, if you do it continuously, it stops working, and you get worse. You actually get worse with ketosis, that's why you have to cycle in extra carbohydrates a few times a week, once you reach that ... which probably increases hydrogen gas production, more than likely.

Tyler LeBaron: It may, there's so many effects of hydrogen gas, and I guess we didn't quite finish the safety portion.

Dr. Mercola: [inaudible 00:34:43] divers and everything?

Tyler LeBaron: Yeah, so the fact that hydrogen gas is produced in the intestine is a great indicator of its safety. We're always exposed to basal levels of hydrogen gas in our blood, in our breath, all the time. Anybody can have it, pregnant, the child, everybody. Hydrogen gas itself is very safe. They have used it in deep sea diving to prevent decompression sickness since the 1940s. Their human studies on showing the safety of hydrogen gas are very powerful, showing at millions of time power concentrations.

I mean, 10 atmospheres of pressure and higher of hydrogen gas, 98% hydrogen gas, very high levels with no chronic toxic effects. It does appear to be very safe. Now, I'm not saying there are zero side effects. We don't know. We can't say that. There may be certain conditions where hydrogen gas could be bad for, but what we've seen so far is hydrogen gas is-

Dr. Mercola: Well, one speculation is to take it continuously, because then you essentially aren't able to gain-

Tyler LeBaron: To get the benefits of it.

Dr. Mercola: Right, because you're not getting the benefits. You're almost indirectly causing damage, because normally you wouldn't be exposed to cyclical exposure from your gut or from other sources.

Tyler LeBaron: That's an interesting idea, yeah, yeah.

Dr. Mercola: I mean, essentially you're not going to get a side effect from taking it, unless you really abuse it, because then you're just not getting the benefits.

Tyler LeBaron: Right, right, yeah. That's the thing. We really need to see more clinical studies. Some of the clinical studies that have been out, they're quite powerful. I need to tell you. You're going to love this.

Dr. Mercola: You just got back from a lot of research?

Tyler LeBaron: Yeah, I was just in China. I spoke at the Chinese BioMedical Symposium there and then previously the one in Japan I attended. I just remember the study, quite powerful, a couple of studies actually I want to talk about. One of them, they compared inhalation of hydrogen gas, about 3% hydrogen gas inhalation, with a cerebral infarction, which can cause a stroke and very problematic. They had 50 patients, 25 on the hydrogen inhalation, and then 25 in the control group.

In the control group it wasn't just air they inhaled. They actually compared it to an approved medical drug. Of course, that's a scary thing to consider, because what if you're in the hydrogen group and you don't know if it's going to be therapeutic or not. You'd rather be in the group that's been clinically demonstrated to be good. Well, they were able to do the study, because the animal studies and different things were very powerful.

Well, they did the study and they found that the group on the hydrogen was significantly more effective than the approved drug on all the measured parameters, with no side effects. Again, if you can't tell, it's why I'm so passionate about hydrogen is because here we have a molecule that is simple, safe, easy to administer, and actually has some really significant therapeutic potential. There was just another study, just barely published, for mild cognitive impairment, Alzheimer's disease.

If you looked at the genotype, those with the APOE4, which genotype is very susceptible to Alzheimer's disease. In fact, about 50% of Alzheimer's disease patients are APOE4. When we look at the effects of hydrogen, drinking hydrogen-rich water, it was a one-year study, about 100 patients or so, they found hydrogen was significantly therapeutic at helping in this disease. That's big because there are no, at least that I know of, approved drugs that are effective for Alzheimer's disease.

Dr. Mercola: No, but there's approved strategies, and one of them is-

Tyler LeBaron: Okay, strategies is different. [crosstalk 00:38:51]

Dr. Mercola: There's no question, but it's interesting, you mentioned the APOE4, because I interviewed Dr. Dale Bredeson before. He's really, I view as one of the world's leading experts in Alzheimer's and who gets it at a very profoundly deep level. He shared this amazing insight about APOE4 and related to the fact that almost all humans, all of our ancient ancestors were all APOE4 double homocytics.

Tyler LeBaron: Is that right?

Dr. Mercola: Yeah, and it actually benefits health if you're able to apply what it's designed for, which is that we were never designed to eat, if you're APOE4 especially, continuously. You've got to do fasting. If you don't fast, you're going to get neurodegenerative changes that progress into Alzheimer's. Again, this whole [crosstalk 00:39:43]

Tyler LeBaron: Well, then, if that's true, which I don't know, it's new to me, but it's interesting because hydrogen, one of the pathways that hydrogen seems to mimic is that of fasting. You look at the, for example, there's an article published in the Journal of Obesity, which was a Nature Publishing Group also. They found that hydrogen was able to induce hepatic growth factor or FGF21, fibroblast growth factor 21. Well, that's huge.

This induces energy metabolism, and when they compared in the study, they found that effectively, drinking hydrogen-rich water had the same effect as about a 20% quota constriction. Then there was an additive effect when there was a quota constriction and the ingestion of hydrogen-rich water. We're seeing hydrogen, okay, for example, when we fast, one of the first hormones we start to produce is ghrelin. Ghrelin is a hunger hormone, but also, it can increase growth hormone levels. It's very neuroprotective, has anti-inflammatory effects, it's very good for the body.

Hydrogen can induce gastric ghrelin production. In fact, that was shown to be one of the primary mediators in benefiting Parkinson's disease from drinking hydrogen-rich water. Many of the animal studies, other than the mentioned one earlier, but many animal studies, including a double-blind and placebo controlled clinical trial that was about a year long with 100 patients or so, also showed hydrogen was very effective in Parkinson's disease.

Now they're just finishing up a three-year clinical trials on a few hundred patients. What we see though is hydrogen is able to benefit this Parkinson's disease, likely via inducing gastric ghrelin production. We have ghrelin production mediated by fasting and also FGF21 and the increase in the whole energy metabolism. It's very interesting, hydrogen seems to mimic some of these same pathways, so it's interesting that you brought that up. Maybe there's some other correlations to be investigated.

Dr. Mercola: Yeah, I've got another question for you, too. You've talked about its benefit in neurodegenerative diseases like Parkinson's and Alzheimer's, and also for cerebral vascular axis and heart disease. Two of the other big diseases out there would be obviously cancer and diabetes. Are you aware of any studies that have looked at hydrogen applications?

Tyler LeBaron: Sure. If we look at diabetes, and we can put that in with metabolic syndrome. There's several clinical studies on the metabolic syndrome. In fact, we're just finishing one article, an animal study with a high-fat diet induced, non-alcoholic fatty acid liver disease, and-

Dr. Mercola: There should be a high carb diet that does that.

Tyler LeBaron: Yeah, that's true, too, right?

Dr. Mercola: That's been my experience, most of the high carb [crosstalk 00:42:26] unless it's really bad.

Tyler LeBaron: Yeah, well that's something we can investigate later also, but this is just a model that's been very [crosstalk 00:42:34] right?

Dr. Mercola: Probably industrially-processed vegetable oils [crosstalk 00:42:40]

Tyler LeBaron: Well, what we found though, the results are significant. There's several studies out there. Hydrogen was very effective at preventing the damage done to the liver. In some of the metabolic syndrome studies, those with impaired glucose tolerance, a few of those patients, their glucose levels were brought back to the normal range. The various markers of ... There's so much we could go into about the diabetes.

Hydrogen in some of the animal studies, hydrogen may actually induce GLUT4 translocation by a similar mechanism of insulin, potentiate insulin secretions. We need more studies to investigate this, but some of this preliminary data is really showing it's a great for these diabetics.

Dr. Mercola: What about cancer?

Tyler LeBaron: Okay, so cancer-

Dr. Mercola: Which is the big one, I mean, it's a useful modality as an adjunct, certainly not the primary treatment, but as an adjunctive treatment in approaching cancer.

Tyler LeBaron: Yeah, I don't know, to be honest.

Dr. Mercola: [crosstalk 00:43:42] look at it?

Tyler LeBaron: Oh, no, people have looked at it. I'm just cautious. Cancer is difficult. Cancer is not just, "Oh, they have a genetic mutation."

Dr. Mercola: No, it's not a genetic [crosstalk 00:43:52] Genetic mutation is secondary to the oxidative damage.

Tyler LeBaron: Yeah, we have a metabolic disorder, we have genetic disorders. We have so many things, right? Hydrogen helps induce cell survival, helps induce proliferation, so in some rationale we could say, "Well, maybe hydrogen is not so good for cancer because maybe it's going to protect the cancer." We have some evidence for that, but then there's also some good evidence to suggest that maybe hydrogen is very good to combat cancer.

In fact, one of the first studies on hydrogen therapy was done in 1975 by Texas A&M and Baylor university, published in the Journal of Science. They transplanted melanoma tumors in mice, and did a hyperbaric, hydrogen chamber, okay, and they found that the hydrogen therapy in this condition was very effective at regressing the melanoma tumors.

Dr. Mercola: Interesting.

Tyler LeBaron: I mean, it was very impressive. It probably didn't continue on with the research, because it's not really practical to do such a high atmospheric pressure of hyperbaric hydrogen therapy, but then in 2007, when we showed that we could

use feasible physiological levels of hydrogen, that's really what spawned the generation of hydrogen research. Then there's other studies. Just at this symposium that I spoke at-

Dr. Mercola: In China?

Tyler LeBaron: Yeah. There were probably three or four other researchers who talked about their research on cancer specifically, and showing that it had a very good effect at suppressing cancer growth. We need more research. One of the clinical studies was done with radiotherapy on, I think liver tumors, and they found that hydrogen was at least effective at improving the quality of life of the patient, and of mitigating the toxic side effects of the drugs, an animal study showing a decrease in the chemotherapy, the side effects of the drugs in chemotherapy, but without altering any of the anti-tumor effects. I think what you said may be key, maybe not as a primary treatment, right?

Dr. Mercola: It can't be the primary treatment, there's no way, yeah.

Tyler LeBaron: As a secondary or adjunctive-

Dr. Mercola: Adjunctive, yeah.

Tyler LeBaron: Yeah, I think-

Dr. Mercola: It would be intriguing to see someone do a study where they're integrating hyperbaric oxygen with hyperbaric hydrogen.

Tyler LeBaron: Actually that's being done right now.

Dr. Mercola: It makes a lot of sense.

Tyler LeBaron: It's a very good idea. Any time you want to combine an oxidative type therapy, you want to use hydrogen, because you always have damage from oxidative therapy. The damage is, the pros outweigh the cons, but hydrogen can help mitigate.

Dr. Mercola: Yeah, in fact, I do that almost every day when I'm home. I do an ozone sauna and before I go into the sauna I take my hydrogen, because I want to mitigate the side effects from the ozone and get the benefits though.

Tyler LeBaron: Yeah, yeah, just to [inaudible 00:46:56] up with cancer, we don't know, but as more of the data is coming out I'm feeling a little bit more comfortable that maybe, especially when there's no other hope in sight, it's probably not a bad idea.

Dr. Mercola: I'm sure we've stimulated lots of people's interests in this, and they might be running out to their computer, and searching Google and how they're going to

get this, so I think it's pretty wise now to go into how you can access available hydrogen therapy, because there's a lot of different ways, and you're certainly an expert on that.

Tyler LeBaron: Well, yeah, I'll talk in general sense about some of the methods and mechanisms. We don't sell or represent any hydrogen products, so you can go to our website and learn more-

Dr. Mercola: You're not going to [crosstalk 00:47:40]

Tyler LeBaron: Yeah, and you won't find any hydrogen products. We don't endorse or recommend anything, but there are many ways to administer hydrogen and that's what I love about it. We talked about the inhalation of hydrogen gas. There are inhalation machines that you can buy. People make inhalation machines. One of the potential concerns, again I haven't looked into this specifically. It's not what I do, but when you do electrolysis of water, for example, you do produce hydrogen gas.

Just by inhaling the gas produced at the cathode, that's hydrogen gas, but if those electrodes are not pure the water you're using has, say it's chloride, then you can get chlorine produced out of that and then you could be inhaling that. You just have to be somewhat cautious.

Dr. Mercola: Pay attention to the details.

Tyler LeBaron: Those details. You don't want to be inhaling something that actually could be toxic for you. Inhalation is one method. You also have hydrogen-rich bathing and actually, as a quick digression, but there is some interesting ... The traditions we hear from the Fountain of Youth and Ponce de Leon, all these different things. Some of these healing waters around the world, people have actually gone back to those waters and they've actually shown that they contain small amounts of hydrogen gas in them. Perhaps those waters did have some benefits.

Dr. Mercola: I think sulfur, too, it's like hydrogen sulfide.

Tyler LeBaron: Sure, hydrogen sulfide is good for you and they can just be lacking some constituents like iodine or something, but it is interesting some of these connections that hydrogen gas could be in there. Bathing in hydrogen water is a great way to do it. Then of course, there's simply just drinking hydrogen-rich water. There's a number of ways to do that, whether it's just a tank of hydrogen gas and you bubble it into the water and dissolve it under pressure, and then restoring hydrogen in ready to drink cans for example, or other pouches.

Well, this will work, but you can't have hydrogen water stored in say, plastic containers, because hydrogen is the smallest molecule. It will dissipate right out of the container.

Dr. Mercola: Yeah, and just to re-emphasize what you said earlier, one of the reasons why it's so therapeutically beneficial, because it permeates every membrane in your body. There is not a space that it cannot get into, whether it's your cell membrane, the blood-brain barrier, the mitochondrial membrane, it goes there. Just nothing stops it.

Tyler LeBaron: Yeah, it can easily permeate everything and so if you see hydrogen water and it's in plastic bottles on the shelf, or something-

Dr. Mercola: It's not real. That hydrogen is long gone.

Tyler LeBaron: Right, if there was anything in there. Maybe that's a clarification. Some people when they hear, "What do you mean, add hydrogen to water. Isn't water already H2O?"

Dr. Mercola: Yeah, yeah, good point, expand on that.

Tyler LeBaron: Okay, remember, the structure of water looks like Mickey Mouse. You have the oxygen and then the two hydrogens, and they're attached to the oxygen. They're attached to the oxygen. Like glucose or sugar, it's C6H12O6, there's six carbons and there's 12 hydrogens. Those hydrogens are all bound to the carbon or to the oxygen, so completely different molecule to sugar and water, right, but they all have hydrogen. Most compounds have hydrogen in them.

Hydrogen gas, like we mentioned earlier, was just two hydrogen atoms that are bound together, and that's hydrogen gas. You can take this gas and bubble it, dissolve it into water. It doesn't attach to the water molecules. It doesn't make H4O or H3O or any other [crosstalk 00:51:08]

Dr. Mercola: You're not going to make structure for it.

Tyler LeBaron: Yeah, it doesn't-

Dr. Mercola: We don't want to confuse you.

Tyler LeBaron: Yeah, we don't want to get into any of this other realm, if you will. It's just hydrogen gas dissolved in water. You can take CO2 gas, oxygen gas, and dissolve that into water.

Dr. Mercola: Like sparkling water.

Tyler LeBaron: Yeah, I mean, okay, if water already had oxygen gas, so can't you ... No, water already has oxygen, so can't you just breathe water? Of course not, because the oxygen is tied up with other bonds. Same thing with the hydrogen, so it's the hydrogen gas. You can take the gas, dissolve it into water, and then you can drink it.

Dr. Mercola: Or bathe in it.

Tyler LeBaron: Or bathe in it, or do intravenous hydrogen-rich saline injection. There's a hyperbaric hydrogen therapy, which actually, when I was in Japan earlier this year, and there is a hyperbaric hydrogen chamber that has been developed.

Dr. Mercola: Oh, nice.

Tyler LeBaron: You can go in there and do a little session. I'm not sure how, of course, it compares therapeutic-wise, but there's so many ways.

Dr. Mercola: [crosstalk 00:52:06] concerns because it is flammable.

Tyler LeBaron: Well, it's only flammable above a 4.6% concentration.

Dr. Mercola: Oh, hyperbaric wouldn't ... You can have hyperbaric at less of-

Tyler LeBaron: At less, exactly, so if you look at the Muller ratio, right, it still may be okay. Yeah, it's interesting.

Dr. Mercola: When we think of flammable, we think of the Hindenburg, which was [crosstalk 00:52:26] hydrogen.

Tyler LeBaron: Exactly, exactly. One thing I'll say, you can measure the concentration of hydrogen gas to see if it's really good. You don't want to use, for example, there's ORP meters, oxidation-reduction potential meters. Those are meaningless when it comes to hydrogen water. Of course, if you measure the ORP of a hydrogen water, you'll get a negative number, because hydrogen is a reducing agent, according to the Nernst equation. It's a redox balance, it's a ratio.

It's not going to measure hydrogen gas. It's very sensitive to pH in that case, because it's a redox couple. Hydrogen gas is difficult to measure, though, [inaudible 00:53:09] like gas chromatography, or a specific hydrogen electrode of a standard calibration curve, because hydrogen is not an ion. Oxygen is paramagnetic, so you can have a sensor for that, but hydrogen is not. It's diamagnetic. So many properties make hydrogen difficult to measure, but there is the redox titration reagent, H2 Blue.

Dr. Mercola: Which you can get [crosstalk 00:53:30]

Tyler LeBaron: Which you can get, yeah, h2sciencesinc.com or other websites. There's so many places that sell [crosstalk 00:53:35]

Dr. Mercola: Amazon.

Tyler LeBaron: Yeah, they sell it in Japan, it's in Korea. There's other companies that have their own product. I'm just saying, it's something very easy, and you can measure the concentration of hydrogen and you can see for yourself.

Dr. Mercola: Yeah, maybe just go over a minute or so what the process is like to actually do it by titrations, and find out what the concentrations are.

Tyler LeBaron: Sure, and there's lots of explanations out there, but briefly you fill up the water, a little beaker of water, say six milliliters of your hydrogen water. Now, if there's no hydrogen gas in there, and you take the reagent, which has methylene blue and a [inaudible 00:54:10] platinum to act as a catalyst, and you add that in there. If there's no hydrogen in the water, it will just go blue and stay blue.

If there is hydrogen gas in there, and you add a drop in there, it'll turn it from blue to clear. It'll go clear, and then you add another drop. You keep on adding them step-wise until the solution turns blue and stays blue. That's called a titration endpoint and you just count how many drops did it take to get there. Each drop is equivalent to about 0.1 milligram per liter, so if you added 10 drops you have one milligram per liter and so on.

Dr. Mercola: Maybe you could discuss therapeutic ranges or targets with some of these things, because you discussed the different routes of administration, but I think it's going to be important to figure out what the dose is.

Tyler LeBaron: Yeah, and I don't know, okay? We don't know what the minimal effective concentration is [crosstalk 00:55:08] Yeah, with the MED. There's so many things to consider because, especially when we're talking about a gaseous signal modulator, that we're talking about intermittent exposure, right? Then we need to have not only an MED, but we need to talk about time scale, a time factor, right, and its half life.

All I can tell you is, what we have shown to be effective or therapeutic in the clinical studies. If you look at hydrogen water, the clinical studies have ranged anywhere from you receiving between 0.5 milligrams to 1.5 milligrams and higher, even 5 milligrams, of hydrogen per day. These ranges appear to be therapeutic. If you get less, maybe for some diseases, for some people, for some conditions, in some circumstances, for maybe a chronic use, maybe it's still effective.

In some cases you may need a higher concentration. Again, we need more research, but it appears, at least in some of these studies, that a higher concentration or a higher dose is more likely to be effective.

Dr. Mercola: Especially if it's intermittent.

Tyler LeBaron: Yeah, it should be intermittent. I think the research has become more clear on that. IHSA, International Hydrogen Standards Association, that is the current

recommendation when it comes to hydrogen products. You should get .5 milligrams of hydrogen. You need to be able to get .5 milligrams of hydrogen by consuming no more than one liter.

Dr. Mercola: Okay, I was going to ask you, the volume.

Tyler LeBaron: Right, and the reason why is because yeah, you could take, "Okay, well, I'll just drink four liters of this 0.2 milligrams" or something. Well, then maybe if you did that, that's a very small amount taken throughout the entire day, so the cellular concentration would never go above, say, four or five micromolar. What we need to get higher, maybe eight to 20 micromolar in order to induce a therapeutic effect, so this is why we're saying, "Okay, limit it to one liter."

There's so much discussion going on here, and it's very exciting to be a part of, but we need more clinical research. Actually, I want to talk about the dose in general, because when we talk about okay, 0.5 milligrams or two milligrams of hydrogen, the saturation-

Dr. Mercola: It doesn't seem like a lot.

Tyler LeBaron: 1.6 milligrams per liter, yeah, it doesn't seem like a lot, but actually it's significant. You have to remember, hydrogen is the lightest molecule in the universe. Its molar mass is two grams per mole versus, say, vitamin C is 176 grams per mole, so it's a lot lighter. When you compare on a molecule to molecule, a mole to mole, it's a lot. To do a quick comparison, a saturated liter of water, with 1.6 milligrams per liter, actually contains more molecules of hydrogen than there are molecules of vitamin C in 100 milligram dose.

There actually is significant, and if we look at other biomolecules, some molecules operate effectively at a nanomolar range, but we take hydrogen, we're still at a micromolar range. It's enough, but most importantly we do see the therapeutic effect in the animal cell and clinical human study.

Dr. Mercola: What do the studies suggest with respect to the half-life and the timing of the dose, and the frequency?

Tyler LeBaron: Okay, sure. In terms of half-life, for example, if you were to drink hydrogen-rich water, depending on the dose that you take in, you're going to reach a peak blood level and breath exhalation, because hydrogen when you consume it, it goes into the stomach and absorbs into the blood. Then it gets pumped to the heart and to the lungs, and you exhale a lot of the hydrogen gas out. You see that peak anywhere between five to 15 minutes. Then that peak goes back to baseline, because you have base loads of hydrogen.

It goes back to baseline in about an hour or so. That's the half-life of hydrogen. That's also where we know hydrogen is much more in terms of, it's more of a signal modulator, because you can drink the hydrogen water, and it's gone out

of the system within an hour, but yet it has residual, therapeutic, protective effects that last for hours, days, and even weeks. One of the studies in rheumatoid arthritis, a double blinded, randomized study, small, but they found that drinking hydrogen-rich water was very effective for the disease.

Now they're doing a very large study of 170-something patients that they're getting ready to do, but it was very effective. In this study they found that hydrogen, it actually with those with early, early onset rheumatoid arthritis, they had a remission of the disease.

Dr. Mercola: That's interesting.

Tyler LeBaron: Doing the washout period, no one was taking hydrogen during this time, and they continued to monitor. They actually continued to see improvements in the disease for an additional four weeks.

Dr. Mercola: That is odd, because just from what you shared about the mechanism, it doesn't seem like that would do that, because it seems to be targeting oxidative stress and inflammation, whereas in that scenario you're actually targeting the actual mechanism of the cause, the foundational cause.

Tyler LeBaron: Because, you're targeting gene expression. By taking hydrogen, within three days we see increases in pdt1 alpha for example. pdt1 alpha is mitochondrial biogenesis. That's a huge area but we see decreases in NFAT, for example. There's so many different transcription factors hydrogen operates on, so if we start to alter the gene expression, then some of these changes of the signal modulator can last for quite some time, so we get those residual effects. This is why I'm very excited to see the clinical studies.

Dr. Mercola: I'm happy to hear that, but I just don't want to give people a mis-impression this is a magic bullet. Just as in cancer, it's an adjunctive factor, it's to be done synergistically with other things that we know are beneficial to produce health and address disease.

Tyler LeBaron: I think that's critical, because hydrogen, in my opinion for example, you can't say hydrogen is a powerful antioxidant.

Dr. Mercola: No, you can't.

Tyler LeBaron: The reason why hydrogen is so good is because it's a weak antioxidant. It's a humble molecule. It's very mild and it's able to go in and slowly do things. When you talk about doing a lot of things, you make ... "By these small and simple things are great things brought to pass," right, and that's how hydrogen works.

Dr. Mercola: You've provided a load of information to intrigue and excite people about this really, highly-beneficial adjunct to their health. I'm wondering if you can provide some recommendation or words of caution, perhaps, with respect to anyone

out there who's really motivated and wants to get this, and starts hopping on Amazon looking for hydrogen. What would you advise?

Tyler LeBaron: Well, first off, the research is still in its infancy. There's so much more we have to do. We don't have hundreds of years of clinical studies that are just long-term. We have preliminary data. We have some pretty neat human studies. We need more, so we're not saying this is a cure-all, this is the end. We need more studies. We still have not proven the actual mechanisms.

It's being worked on. I happen to know some confidential information, very excited about it, but these are not published. We don't have this data yet. We haven't proven exactly how it works, which is okay. There's lots of pharmaceuticals that we know have this effect, but we don't know how they work.

Dr. Mercola: Sure, when I went to medical school we did not know how aspirin worked. We do now, but we didn't when I was in school.

Tyler LeBaron: Exactly. It's okay but we still don't know many things about hydrogen. We still need a lot more research, so that's one thing I caution, is don't be thinking, like you said, this is some miracle thing that's going to cure everything. We don't know. We need more research, just very exciting, we're on the cutting edge right now. The second thing is, there is a lot of scams. It's a big market, so there's a lot of companies trying to come in, "Oh, I'm going to make hydrogen water."

There's companies who are just selling normal water and calling hydrogen water because they think, water's already H2O, so they just change the name. That's not hydrogen. Just because a company claims hydrogen, or because a company claims a certain concentration, it may not be true.

Dr. Mercola: This is easy to check, because you can buy this test.

Tyler LeBaron: You can buy the test reagent.

Dr. Mercola: What is it again, true blue?

Tyler LeBaron: H2 Blue. There's another one out of Japan. They make it in Korea.

Dr. Mercola: You can test it yourself and just confirm [crosstalk 01:04:06] You should.

Tyler LeBaron: Yeah, and once you get to know a certain company, you're able to maybe evaluate, so that's my second concern or caution, is just don't jump at the first thing that says, "Hydrogen, the next big thing." Then, lastly, I just want to reiterate again, it's nothing to do with alkaline water.

Dr. Mercola: Yeah, yeah, thank you, I almost forgot to mention that, but that was some of the excitement. Alkaline water, essentially, and I've written articles on it, does not work. It does not work. It's nothing to do with the pH. If it works, it's due to hydrogen, so why don't you expand on that?

Tyler LeBaron: This is just such an interesting history. Alkaline ionized water ... The Japanese government's very strict. They're stricter than the FDA. In my opinion FDA is underfunded, and that's why we have a lot of problems.

Dr. Mercola: It's also corrupted.

Tyler LeBaron: Exactly, that's why it's so corrupt, well, not saying that's why. There's so many issues. The Japanese government is also very strict. They had this idea of applying alkaline ionized water for agriculture and later for human use. They had to get the Japanese government approval in order to even start doing that. They did that. Similarly, we have the FDA approval for dental floss, for example, anything that's going to be used on the human body has to be a medical device.

They got that approval, but no medical doctors, no scientists thought anything of it. It doesn't make any sense that alkaline water could do any of these benefits, because even if you subscribe to the idea that we need to alkalize our bodies, you can't do it.

Dr. Mercola: There's probably some benefit to it.

Tyler LeBaron: Yeah, which we're not even discussing that, right, but even if you subscribe to that, you can't do it with alkaline water, because alkaline water is not a buffer.

Dr. Mercola: That's a key point, so explain that, expand on that one.

Tyler LeBaron: A buffer is a substance that's able to prevent changes in pH, okay, and to put it in perspective, if we look at baking soda, sodium bicarbonate, which is our body's natural buffering system, one teaspoon of baking soda can neutralize the same amount of acid as over 700 liters of alkaline water at a pH of 10.

Dr. Mercola: Which is pretty high pH.

Tyler LeBaron: It is, and baking soda-

Dr. Mercola: Most people aren't going to drink a pH of 10.

Tyler LeBaron: Yeah, once it goes above pH 10, according to some of the Japanese studies, it's not a good idea anyway. Baking soda has a pH of 8.1, so it's not a buffer. What happened in Japan is, nobody really accepted this idea, but it started going in the marketplace and it started getting a lot of press, especially in the '80s. It started getting a lot of press, because people were receiving these anecdotal benefits, like "What? I'm getting this and this."

They started doing this research in the '90s, also in Korea in the '90s started doing research, and they found this alkaline ionized water, electrolyzed reduced water, appeared to have some sort of antioxidant and antidiabetic and anticancer effects. How was this possible? The researchers didn't know. We have the studies, but they really didn't know. They were just saying, "This is what we're finding in the research."

Then, as of course the market grew, well, they had to explain something, so now there was this whole idea of the micro clustering idea, or this free electrons in the water, or the negative ORP, or this alkaline benefit alone, or so many different ideas that were propagated through marketing, but were never scientific.

Dr. Mercola: Never validated.

Tyler LeBaron: Never validated. The scientists themselves never said that, continued to do some research. Then what happened was that article in Nature Medicine published in 2007. Now some of these other researchers saw that publication, they thought, "Hey, when you do electrolysis of water, by definition, you produce hydrogen gas. What if hydrogen gas is responsible as a therapeutic agent?" Before that, everyone thought hydrogen gas was just a byproduct. Read the article, it's so interesting. Then they're like, "Oh, we're going to produce hydrogen gas." Many of them won't even mention hydrogen gas, right?

Dr. Mercola: Yeah, because it was insignificant.

Tyler LeBaron: Because hydrogen's always been considered to be essentially biologically inert, would have no therapeutic effect. That's why those ideas of active hydrogen, which is a reactive atomic hydrogen, a hydrogen radical, and that was the first idea that emerged. Maybe hydrogen has an effect, was an inactive hydrogen radical form, which would be totally impossible.

It's completely unstable in that form. Anyway, some of these other researchers, they're like, "Okay, that's a simple study to do." We have Dr. Lee from Korea. He is the pioneer researcher in alkaline ionized water from the 1990s. He's one of the first persons to show these effects. He's also one of our advisors. You can look him up on our website. You'll see where he started, MD, PhD and all this. He started looking at this.

Well, he did the research, and he found, "Hey, when I take alkaline ionized water and I remove the hydrogen gas from the water, even though the pH is the same, even though all these things [inaudible 01:09:08] the benefits are eliminated." The benefits were the [inaudible 01:09:12] of the hydrogen gas. The hydrogen gas is responsible for the negative ORP. If you remove all the hydrogen gas, the ORP does go back up positive, but you only need .5 milligrams per liter to get a negative ORP. You can have a negative ORP, up to negative 200, probably won't be therapeutic.

The reason why? There's no hydrogen gas in there, well, not enough. It's very low [crosstalk 01:09:33] level, but anyway, he showed it many times, many studies. In fact, our study on non-alcoholic, fatty acid liver disease that I talked about, that was originally done by the group in Israel using alkaline ionized water. Just like all the studies, they did electrolysis for a couple of hours, they had a very high pH, very high negative ORP, all these things.

They did the study, very disappointed because no effect. I then explained to them the hydrogen gas. They did the exact same study, and now we're collaborating on this. This was a couple of years ago. We've been collaborating on this for a while now, and now all of a sudden, they see the effects of hydrogen gas. We did two, we did a low concentration of hydrogen, and a high concentration of hydrogen. The low concentration of hydrogen, still no effect. The higher concentration of hydrogen was very therapeutic.

Dr. Mercola: What was the high concentration?

Tyler LeBaron: I think we had .2, .3 milligram per liter for the low, and then .7 or .8 milligram for the high.

Dr. Mercola: It's still not very high.

Tyler LeBaron: It's still not very high, right, because animals drink my water, but still, this again showed ... Well then, the last one in Japan, Dr. Mami Noda from Kyushu University, she was also one of the first researchers on alkaline ionized water. She also researched at Rockefeller University. She's a very good pharmacologist researcher. She had friends come to her who were drinking alkaline ionized water and say, "Hey, Dr. Noda, I'm getting better. How is this possible?"

She, being a scientist, "Well, I don't know. First, I don't know if this is even true. This is very strange. It doesn't make any sense scientifically," but she tried it. In her study, she took animals, she induced Parkinson's disease, gave them hydrogen water, and she showed that hydrogen water prevented the development of Parkinson's disease. She also was curious, how is this possible? Saw this publication, Nature Medicine, and then did the exact same thing, did the exact same studies, and then removed the hydrogen gas from the water as well as simply bubbled hydrogen gas into water, and it was very clear that only the hydrogen gas was responsible for mediating the benefits.

This Parkinson's disease study, and a different one from Nagoya university ... I need to tell you how Dr. Kinji Ohno, also our advisor, but that's who I worked with when I was in Japan, how he got interested in hydrogen. It was also because of Parkinson's disease, okay. He heard a lot of these things. Nagoya is the fifth most prestigious university in Japan. He's a very respected researcher, so he's not just going to dabble into something.

He's heard about this and he's like, "You know, I'll try it." In his lab he also developed a model to induce Parkinson's disease, and he saw that drinking hydrogen-rich water prevented the development of Parkinson's disease. In his words, and you can read it, it's on the website, his quote. When he saw in his own lab, with his own eyes, that hydrogen had that effect, that changed his research career and got him interested into the hydrogen biology and specifically to elucidate from molecular mechanisms behind how hydrogen is having this effect.

Maybe post video we can put up something, and I'll show you what they saw, and you'll see the rats, the differences between drinking hydrogen water and drinking control water.

Dr. Mercola: Sure, we can easily do that, sure.

Tyler LeBaron: Anyway, we need a lot more research, but very exciting what we're seeing, because we're actually seeing that the studies from the animal studies are being transmitted to the human studies. We're actually seeing that there's an effect in humans as well, not just in animals.

Dr. Mercola: Absolutely, well, that's great, so exciting, it really is. Just to finish off the alkalizer water because most of the alkalizers out there, they produce hydrogen gas.

Tyler LeBaron: By definition, yeah.

Dr. Mercola: They have to, but here's the problem, that most of them also produce scale. Essentially scale, these catalyzers, what is the actually device that does it?

Tyler LeBaron: Well you have the [crosstalk 01:13:29]

Dr. Mercola: They're like [crosstalk 01:13:28] right? Once the electrodes become scaled-

Tyler LeBaron: Yeah, mineral depositions.

Dr. Mercola: Then they don't work and you're not, not only not getting the low pH or a high pH but you're also not getting the hydrogen gas, or it's certainly reduced.

Tyler LeBaron: It's interesting because the mineral buildup it appears, and we didn't know this until the H2 Blue was available so we could actually measure. Yeah, we see that all of a sudden, after a few weeks of use, first off, if you have a low TDS water, you may be able to produce a high pH, but you won't have dissolved hydrogen gas. This process needs some minerals to act as some nucleation sites to dissolve the hydrogen. Then if you do live in a place that has a higher TDS, then after a few weeks of use then you can get the mineral deposits on the electrodes and it prevents the gas from dissolving in the water.

That's why, check the companies, all of them will make a big deal about cleaning the machine, cleaning the electrodes, whether they're running acidic water or doing reversing polarity. It's because-

Dr. Mercola: Most people don't do that.

Tyler LeBaron: It's a lot of work.

Dr. Mercola: Yeah, lots of hours of work.

Tyler LeBaron: Yeah, accumulates, so yeah, the mineral buildup prevents the gas from dissolving because these water ionizers, they were all developed for an alkaline pH, not hydrogen gas. In fact while I was in Japan a few years ago, not only did they not know, think about it. If you're a manufacturer, and you realize you're producing hydrogen gas, this gas could be toxic. We don't know, so one of the ideas was actually to produce a machine that had the lowest concentration of hydrogen gas but yet still a high pH, because they wanted to be safe, right?

You go to Japan, like [Neehonshun 01:15:15] that's one of the Japanese companies. They own the largest market share by 70% followed by Panasonic, for this area. All of them are changing to hydrogen water. They have their specific machine, they're alkaline water ionizers. They make it "Okay, pH will not go above 90.5." They have a whole different chamber so they can keep the pH low, increase the hydrogen dissolved concentration. Everything in Asia is going away from the alkaline water ionizers and finally to the hydrogen gas.

Dr. Mercola: There's probably still benefit there, but it still has yet to be resolved because the research hasn't been done, is that you're still drinking this all day, so you're approaching a continuous infusion, which violates the original principle of making it cyclical or pulsing it. Drinking it, although it might be effective, maybe you might not want to drink it all day long, or have a higher dose.

Tyler LeBaron: Like you very first said, we don't know. We need more research because if you are drinking it all day long, well, that's still in some sense an intermittent, but maybe it is too close to continuous. Maybe it's better to take just one high-dose in the morning and one at night. Yeah, we don't know, but what we do know, it's providing a therapeutic effect. You're not going to go wrong.

Dr. Mercola: No, you're not going to hurt yourself.

Tyler LeBaron: There could be a better way, but we need more research to see, right?

Dr. Mercola: I've known you for a few years and I've been very excited about it, and continue to explore it, and really excited to hopefully, scrub through the details and provide something that would be helpful sometime in the future.

Tyler LeBaron: Well, I'm sure that your viewers would appreciate that. There is a lot of scam products out there, but the research is very promising and like I say, it's very rare that you can come across a molecule that is so safe, yet has such strong therapeutic potential, right? A review years ago, 2013, by Loma Linda University, their review article then showed that hydrogen had therapeutic effects for the top eight of the 10 disease-causing fatalities listed by the CDC, the Centers of Disease Control.

When you look at something like that, yes, hydrogen merits more research, more investigation, more clinical studies, and that's why I'm so passionate about this. I'm very excited to see where things end up with the hydrogen research.

Dr. Mercola: Yes, right. Why don't you share your website?

Tyler LeBaron: Sure, yeah.

Dr. Mercola: [crosstalk 01:17:53] hydrogenfoundation.org, I believe.

Tyler LeBaron: Yeah, that's right.

Dr. Mercola: It's a mouthful

Tyler LeBaron: Yeah, molecularhydrogenfoundation.org, also molecularhydrogeninstitute.org and again, we are a science-based non-profit. We're working to advance the research, the education, and the awareness of hydrogen as a medical gas, so you're not going to find products and things on our site, but you will find a lot of information, and we do our best to provide what's going on in the hydrogen area.

Dr. Mercola: Well, great. Any other concluding comments?

Tyler LeBaron: Yeah, I hope that you'll review this video, review the information on hydrogen, and although we have a responsibility as maybe researchers to understand the molecular mechanisms and targets of hydrogen and do clinical studies, because we have a molecule so significant like this, and so safe, perhaps it's also your responsibility to share it, to spread the awareness to others, let other people know about it. There's so many people who don't have access to medical care, that this could really benefit. There are also those who have access to too much medical care, where hydrogen can help mitigate the toxic effects of such.

Dr. Mercola: Mostly in the United States. Absolutely, well, thank you so much. It's been awesome. I'm so glad you were able to trek your way to Chicago in the frigid cold and we're able to provide some really solid information for our viewers.

Tyler LeBaron: I appreciate it.