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The Science Behind Molecular Hydrogen Tablets

Analysis by Dr. Joseph Mercola ✔ Fact Checked | October 23, 2022

STORY AT-A-GLANCE

- Molecular hydrogen (H2) is a gas with very unique and selective antioxidant effects. It works primarily by improving the redox status of the cell when needed
- Hydrogen is the smallest molecule in the universe, which is why its bioavailability is so great. It's also neutral, so it can easily penetrate any membrane space in your body
- Drinking hydrogen water can double your cellular concentration of hydrogen gas. For about five minutes, your blood level peaks, and this is when beneficial changes in cell signaling and gene expression occur
- Molecular hydrogen is best taken cyclically or pulsed. If you take it continuously — say you're drinking hydrogen water throughout the whole day — the effect seems to dissipate and can actually vanish altogether
- For best results, place two tablets in 1 liter of water and drink it all in the morning. This will give you a very strong pulse, which will produce better results than a lower pulse twice a day. Once the tablets are fully dissolved, you'll want to drink it as fast as possible

Alex Tarnava, whom you may not have heard of before, is the inventor of the open-container molecular hydrogen tablets — my favorite supplement — thus making it widely available in a convenient form.

What Is Molecular Hydrogen?

Molecular hydrogen (H2) — two hydrogen atoms combined together — is a gas with very unique and selective antioxidant effects that specifically target the most harmful free radicals. It works primarily by improving and optimizing the redox status of the cell when needed.

As a result, you see improvements in superoxide dismutase, catalase and glutathione levels, for example. Not only does hydrogen selectively reduce the most toxic radicals, but it can help prevent an excess (which becomes toxic) of the free radicals from being produced in the first place. This is a very powerful prevention mechanism.

H2 also activates the Nrf2 pathway when needed. Nrf2 is a transcription factor that, when activated, goes into the cell's nucleus and binds to the antioxidant response element in the DNA.

It then induces the transcription of further cytoprotective enzymes such as glutathione, superoxide dismutase catalase, glutathione peroxidase, phase II enzymes, heme-1 oxygenase and many others.

A landmark paper[1] on molecular hydrogen came out in Nature Medicine in 2007, showing 2% hydrogen gas was effective at preventing brain damage from ischemia reperfusion and, as an antioxidant, has powerful therapeutic applications. Hydrogen is the smallest molecule in the universe, and is neutral and nonpolar, which is why its bioavailability is so great.

Tarnava's Journey of Discovery

As is so often the case, Tarnava's interest in molecular hydrogen and his subsequent invention was born out of a personal health challenge that required him to dig deeper for a solution. He explains:

> *"I had another business that allowed me a lot of freedom for athletics and exercise. I was training six to eight hours a day. I was training in various martial arts and CrossFit. Then I got really sick. It materialized in sudden-onset narcolepsy. I had central nervous system shut down.*

> *My heavy lifts weren't altered but I couldn't jump on a plate, whereas a couple of weeks before I had the 54-inch plyometric jump. I was sleeping 16 to 15 hours a day. I'd fall asleep if I sat down for about a minute. My bloodwork was bizarre … My C-reactive protein was 34 [mg/dL]."*

Your C-reactive protein should ideally be below 1 milligrams per deciliter (mg/dL), so Tarnava obviously had massive inflammation going on. He was also iron-deficient and anemic, despite eating a lot of red meat and leafy greens.

> *"It lasted for weeks. They couldn't figure it out … When the dust settled, my shoulder was frozen. All the inflammation, the narcolepsy and the excess sleeping just went away, but I had a frozen left shoulder. I basically had arthritis in eight spots overnight. At that time, hydrogen was already on my radar, so I bought a machine for $5,000."*

Inventing Molecular Hydrogen Tablets

The problem was, the hydrogen water machine was only producing a very small amount of hydrogen gas. When he tested the water for its hydrogen content, Tarnava found it had a concentration of 0.03 parts per million (ppm), which is virtually nothing. In the end, this is what spurred Tarnava to develop molecular hydrogen tablets that can deliver a consistent concentrated dose when dissolved in water.

> *"I used a bit of a Ray Kurzweilian strategy when I was developing the tablets,"* he says. *"I found experts. I found engineers. I found pharmaceutical formulation firms. I contracted a physicist, a chemist and biochemist …*
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> *Eventually [I succeeded in making the tablets]. I failed a couple thousand times … I was reading a lot of the studies. They're using magnesium in different ways. I tried magnesium sticks. It wasn't working …*
>
> *I started looking to make powders and tablets … At first, the [metallic] magnesium was really hard to get. I had to go through the Department of*

Defense and the state department to be compliant with eight different government agencies to use the magnesium.

Usually when you're buying a magnesium, it's a salt … [Metallic magnesium] is reactive — it's nonionic, elemental magnesium … It's very hazardous to handle in production. We have very, very controlled production.

But it's a very safe tablet. So, our hydrogen tablet is not HAZMAT (hazardous material). It's not explosive. It's not flammable. But it will split the hydrogen off your water …

We're using a very special pharmaceutical grade magnesium that's ground in very specific ways for us to get the nano bubbles … When I first started tinkering around, I had some of it tested. I was getting magnesium in from like Russia and China that was being mislabeled.

I later found they were illegal for export from both places. It's heavily controlled in the U.S. Just to get it out to Canada, it was an eight-month process with the state department doing background checks, facility checks and in-person interviews to make sure I had a legitimate purpose for this stuff."

Poor Quality Hydrogen Tablets May Be High in Contaminants

Tarnava's tablets are also tested and compliant for heavy metals. Tarnava tells the tale of a competitor who did not bother going through the intricate certification processes Tarnava has followed and purchased magnesium from a fireworks reseller, which resulted in tablets that were high in lead.

"We're ultra-compliant in our heavy metal levels. You need 16 tablets a day to hit the threshold for California Proposition 65, which is about 10 times stricter than the pharmaceutical regulations on it, which is even several times stricter than some regulations … For supplement regulations, I think you could take something like a couple of hundred tablets a day …

We went to great lengths to ensure purity and to ensure the framework was in place before we started [production], which is also why we're pursuing so much research with public teams under no publication agreement.

We have five publications already in three years … We have seven more that are underway and six in the planning stage that are finishing up their ethics approvals and protocols. And we have four prominent universities conducting rodent trials using our tablets.

In total, we're now working with nine or 10 public universities around the world to further the research and assist in any way we can, because we want to know more about how it works, what dose should be used and when it should be taken. The data is starting to come out. Things are definitely emerging. Higher dose, higher concentration and intermittent pulse seems to be the best for humans."

The Problem With Molecular Hydrogen Water Generators

Before molecular hydrogen tablets, one of the most commonly used ways to generate molecular hydrogen water was through the use of water ionizers that purport to make hydrogen.

However, they won't work unless you have total dissolved solids (TDS) such as minerals in the water. You cannot use reverse osmosis or distilled water. They will also stop working once the plates used to split the water get calcified from the TDS. Tarnava explains:

"What ends up happening is they'll still make hydrogen, but it doesn't dissolve because the bubbles are too big. It'll still make the same amount of hydrogen, but it's just in and out. It doesn't dissolve in the water.

In a lab, when they're using pure gas to dissolve through a beaker, it might take half an hour of bubbling. Liters and liters of hydrogen to get to 1.6 ppm … But the smaller in bubbles you go, the easier it is to dissolve.

What I figured out is when you even go into the low nano range, you can quasi-dissolve this cloud of gas that doesn't fully dissolve without accompanying pressure, but it also doesn't escape. So, you can get, in a half a liter, 8 to 10 ppm [of molecular hydrogen], instead of the 0.1 ppm that a lot of these ionizers give you.

This is critical because a lot of people look at the rodent research and fail to properly [calculate] … just how much more hydrogen mice are consuming per body weight than humans.

When you take a 25-gram mouse and convert it to an 80-kilogram person (that's 176 pounds for American viewers; that's the average weight of the American), that person would need to drink the equivalent of 12.8 liters of water a day to get the same amount [of hydrogen] that mouse drinks.

Consequently, it's critical because you need to raise your cellular concentrations of hydrogen. If you're only drinking half a liter or a liter a day, then you need to [raise] the concentration to get that proper dosage."

Pulsing and Dosing

Molecular hydrogen is best taken cyclically or pulsed. If you take it continuously — say you're drinking hydrogen water all day long — the effect seems to dissipate and can actually vanish altogether.

As noted by Tarnava, your body naturally produces about 10 liters (L) of hydrogen gas each day through bacteria that break down carbohydrates in your digestive system.

It may seem odd that taking a relatively small amount of supplemental hydrogen gas can make a difference, but when you look at the cellular response between ingestion and inhalation, drinking hydrogen water can double your cellular concentration of hydrogen gas. For about five minutes, your blood level peaks, and this is when beneficial changes in cell signaling and gene expression occur.

> *"Most of what hydrogen does is indirect response from altered cell signaling and changes in gene expression,"* Tarnava explains. *"We simply need that pulsed dose to alter all these things, [because the data shows] when they've given continuous gas administration, and constantly raised the cellular concentration, it's had no benefit, even at a much higher dose, whereas when pulsed, the effect is good."*

In the interview, Tarnava discusses hydrogen gas dosing using both ppm and mg. To clarify, ppm and mg/L are identical and both refer to the concentration of hydrogen in the water. The mg refers to the actual dosage. As noted by Tarnava, getting the correct acute dosage is important for optimal benefits.

When you dissolve two molecular hydrogen tablets in 1 liter of water, you get 8 to 10 ppm of hydrogen gas concentration, which translates into an 8 to 10 mg dose if consumed while the water is "white."

Ideally, you'd want to drink the full liter all at once. If it's too much, you can divide it into two doses, with one tablet in half a liter of water taken in the morning and another half-liter (with one tablet) again in the afternoon.

While it may be tempting to simply put two tablets in half a liter of water, this will not give you the ideal dose. In essence, you're getting a higher concentration of hydrogen, but at a lower dose. The problem with this is that the effects are not linear, and simply raising the concentration but reducing the dose will not provide you will the full effects.

How to Drink Your Hydrogen for Best Results

So, for best results, place two to three tablets in 1 liter (about 32 ounces) of water and drink it all in the morning. This will give you a very strong pulse, which will produce better results than a lower pulse twice a day.

Keep in mind that once the tablets are fully dissolved and the water has turned white — which can take anywhere from 30 seconds to a couple of minutes, depending on the

temperature of the water — you'll want to drink it as fast as possible. Room temperature water is best, allowing the tablets to dissolve in about 90 seconds.

Between 45 and 90 seconds, the water will have a stable concentration of hydrogen at or above 10 ppm. Between one and six minutes, it'll drop from 10 ppm to 1.6 ppm. So, the faster you drink it the better. However, even if you let it sit for a few minutes, you're still getting 1.6 ppm, which is far higher than what you'll get from water ionizers that cost thousands of dollars.

As an added bonus, you're also getting highly available magnesium — about 80 mg of elemental magnesium per tablet, which goes straight to where magnesium is needed. The elemental magnesium does not dissipate, so you're getting that even if you forget to drink it before the hydrogen dissipates.

Blowup Leads to a Surprising Discovery

As Tarnava was creating the tablets, he was also using them on himself. Once he was able to make a tablet that provided 3 ppm in half a liter of water, his shoulder unfroze and the arthritis in his hip eased.

> *"I was drinking 1 liter in the morning, 1 liter in the afternoon and 1 liter before bed. Then I started getting a little bit more hardcore. I started [increasing] the pressure and was getting close to 5 ppm in taking this dose.*
>
> *But I was needing to put the thermoses in vice grips to remove the caps because they were getting knocked off the threads. That was my first run-in with safety control, because one of my thermoses blew up in my fridge."*

The reason for this is because the molecular hydrogen converts to gas, which increases the pressure in a closed container. This eventually led Tarnava to develop an open-container tablet.

Most hydrogen tablets require using a closed container, or else the gas will simply escape. Tarnava's product, on the other hand, can be dropped into an open glass, and

the gas still stays put in the water and doesn't escape.

> *"I think that's really what sets us apart,"* he says. *"That's the basis of most of our IP and what we've done. And it was an accident. We didn't do it on purpose … Our initial goal was to get 3 to 4 ppm in half a liter in under five minutes in a sealed container …*
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> *But every time we'd unseal these fast-reacting tablets, the water went white. This would test very high and return down very quickly. The half-life didn't make any sense. We're beating our heads against the wall. After a few months, it just dawned on me, 'Why are we fighting this? We're getting higher levels by doing this … I wonder how we'd do in an open cup?'*
>
> *It was higher. It was under two minutes at that time … It really didn't make sense. Finally, when we did it in the open cup and we replicated it over and over again, it still didn't make sense. I contacted Tyler LeBaron [a molecular hydrogen expert]. I told him what we were working on. He said, 'I don't believe you. Show me.' I put him online …*
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> *Tyler failed to falsify what we were doing. He did multiple tests. He took them into testing in Japan and China, to different conferences and apparatuses. He asked me to do some tests and I did it. I've been through the same thing with Randy Shark who runs H2 Sciences …*
>
> *He was as or more skeptical than Tyler, but he … [too] failed to falsify what we're doing. Now, as we're getting more data — we're doing gas chromatography, we're doing all these different things — every report … [is] indicating between 8 to 11 ppm in half a liter with one tablet … Nobody else comes close."*

From Illness to Health With Molecular Hydrogen

As Tarnava continued using the hydrogen water, his frozen shoulder and arthritic joints continued to improve to the point where he can now play soccer and work out. He also implemented better sleeping habits, which probably played a role as well, seeing how he

was only sleeping about four hours — half of the recommended amount of sleep you need for optimal health.

He's also doing my cyclical fasting protocol. "I've been doing that for months," he says. "I fast 43 to 48 hours a week every week. Every fourth, I'm pushing it to 72 [hours]. I dropped 40 pounds from February to August."

This brings up an important point: While molecular hydrogen is a fantastic supplement — I take it every day — it's not a magic bullet by itself. It needs to be integrated with other elements of a healthy lifestyle. Tarnava was not doing that initially. Now that he's sleeping more and doing time-restricted eating, and some longer **fasting** as well, his health is starting to significantly improve.

> *"That's actually what excites me the most about hydrogen,"* Tarnava says. *"First, it's shown to have this protective effect … The more damage someone has, typically, the more prominent hydrogen is working to bring them back to homeostatic function.*
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> *But on top of that … hydrogen is shown not just to cancel out and mitigate the stresses from other forms of hormesis, because it seems to be a form of hormesis itself … like exercise … but then, it has this rescuing effect to basically bring recovery faster.*
>
> *In this really controlled rat study, the rats had higher stress, were swimming longer. But as their stress spiked more, their redox regulated faster and their inflammation was blunted. A really cool article I just read this weekend [showed] … it significantly improved exercise performance.*
>
> *But what was interesting is it significantly lowered insulin-like growth factor 1 (IGF-1), whereas exercise raises IGF-1. [The rats] performed better, but they had IGF-1 lowered."*

The Importance of Cycling

As just mentioned, hydrogen works by a process called molecular hormesis, so there's a delayed impact. If you're going to go through oxidative stress, such as flying domestically across the country, for example, you'll want to take it several hours or even days beforehand.

The reason for this is because it has to go through the process of activating your antioxidant genes. Tarnava also recommends cycling your use of hydrogen in order to keep its effectiveness. He explains:

> *"For instance, for my surgery, a month before I cycled off [hydrogen]. Every three to six months, I'll stop taking hydrogen and let all my joints seize and deprive my body of the exogenous hydrogen. And then I change my dosing protocol to keep my body guessing. This seems to kick things into gear.*
>
> *It seems that in the past, when I had the same dose of protocol for a year, that things started seizing back up again. When I get a wash-out period and change [the dosage] … I recover again. I've been telling most people to do the same.*
>
> *Every time I change it, sometimes I'll do it twice a day. Sometimes, I'll do it three times a day … I'll have a higher concentration or a lower dosage. Other times, I exercise five or six days a week and I was only taking them on days I exercise, five minutes before I exercise, which, anecdotally, is when we see the biggest benefit for exercise … especially on heart rate and modifying heart rate."*

Molecular Hydrogen Is a Powerful Health Aid

According to Tyler LeBaron, one of the preeminent experts on **molecular hydrogen**, more than 1,000 peer-reviewed scientific publications have collectively demonstrated that H2 has therapeutic potential in over 170 different human and animal disease models.

In fact, hydrogen is shown to benefit virtually every organ of the human body, and the reason for this is because hydrogen actually targets and mitigates the root causes of inflammation and oxidation.

As mentioned at the beginning, hydrogen has the ability to selectively target the most toxic radicals, and helps prevent their creation in the first place, which is a very powerful prevention mechanism.

For example, clinical studies have shown molecular hydrogen effectively prevents liver damage (fatty liver) caused by a high-sugar diet and metabolic syndrome.[2,3] Animal research[4] suggest hydrogen may actually induce GLUT4 translocation by a similar mechanism as insulin.

To learn more about molecular hydrogen, check out the **Molecular Hydrogen Institute's website**. There, you'll find research, video lectures and a variety of other resources, including a number of different certifications for those interested in working with and administering molecular hydrogen.

Sources and References

- [1] Nature Medicine May 7, 2007; 13: 688–694
- [2] Obesity (Silver Spring). 2011 Jul;19(7):1396-403
- [3] Mol Med Rep. 2017 Mar;15(3):1305-1312
- [4] PLoS One. 2013;8(1):e53913

DrinkHRW: The Science Behind Molecular Hydrogen Tablets: A Special Interview With Alex Tarnava

By Dr. Joseph Mercola

JM: Dr. Joseph Mercola
AT: Alex Tarnava

JM: Welcome, everyone. This is Dr. Mercola, helping you take control of your health. Today we are going to talk with Alex Tarnava. You probably never heard of him. Most people haven't. But he's the genius behind making molecular hydrogen, my absolute favorite supplement, widely available and effective to everyone. Welcome and thank you for joining us today, Alex.

AT: No problem. I'm glad to be here.

JM: Yeah. I met you through Tyler LeBaron, who we both admire and respect for his genius in this area and leadership. But that was virtually. I actually met you in person at the Bulletproof Conference in October of 2017. Yeah. Just a little over two years ago now. I was impressed in what you're able to do. Obviously anyone watching here hasn't had that opportunity so I'd like you to provide us with what your background is and how the heck you got interested in this obscure topic of making molecular hydrogen so widely available.

AT: Yeah. I'll cut it a little bit short because it's a pretty long story. I basically got pretty sick. I did get really, really sick. I had another business that allowed me a lot of freedom for athletics and exercise. I was training six to eight hours a day. I was training in various martial arts and CrossFit. I got really sick. It materialized in sudden-onset narcolepsy. I had central nervous system shut down. My heavy lifts weren't altered but I couldn't jump on a plate, whereas a couple of weeks before I had the 54-inch plyometric jump. I was sleeping 16 to 15 hours a day. I'd fall asleep in a seat if I sat down for about a minute. My bloodwork was bizzare. I forget what the measurements are, if it's nanograms or deciliters. Something with my c-reactive proteins were at 34. Most are between 1 and 3.

JM: Actually, it should be below 1, so 0.7 or 0.3. You're only about 100 times higher than ideal.

AT: But even most infections will get you just over 1 to 3 is what I recall my general practitioner (GP) told me. It was bizarre. Despite that, I was eating about 6,000 to 8,000 calories a day at that point because I was training.

JM: Wow. You had a lot of inflammation going on.

AT: Yeah. But I was iron-deficient and anemic, despite eating a lot of red meat and a lot of green vegetables.

JM: Wow.

AT: It lasted for weeks. A couple of blood tests a week. They couldn't figure it out. My best friend who'd been training for a triathlon at the time, it ravaged him but in a completely different outcome. He developed pneumonia. He had missed a few weeks of work. He was hospitalized a couple of times. He was a super dead guy. It was really bizarre.

When the dust settled, my shoulder was frozen. All the inflammation, the narcolepsy and the excess sleeping just went away, but I had a frozen left shoulder. I basically had arthritis in eight spots overnight. At that time, hydrogen was already on my radar, so I bought a machine for like 5,000 dollars.

JM: This was probably an alkaline water machine, I'm assuming, that may moleculize just as an artifact of producing alkaline water.

AT: Yeah. Exactly. They were marketing the hydrogen pretty aggressively. Hydrogen had been on my radar for a couple of years. I said, "Might as well." I went on 1,000 milligrams (mg) of Naproxen a day, prescription-based. I got a couple cortisone injections in my shoulder. I developed multiple ulcers from the Naproxen in a six months-type deal, and my shoulder completely froze.

JM: Did they ever figure out what was causing all this inflammation? Was it just the over exercising?

AT: No. I don't think so.

JM: What was it?

AT: At first they were like, because I had some different – They thought maybe it was that. But I stopped training and it didn't go away. Something very different happened to my best friend and my roommate at the time. He developed pneumonia. They thought it was some sort of virus. They just couldn't figure out what. It never got figured out. But it left me with all this arthritis, osteoarthritis and joint degradation.

When I went back to PubMed and I was just looking, looking, looking, anything to kind of regulate the inflammatory response because I couldn't take non-steroidal anti-inflammatory drugs (NSAIDs) anymore. I didn't want to keep – The last cortisone injection I did only released my shoulder for about six days. I was in a sling for I think three days, and then I felt better for six. It just wasn't worth continuing to do that. I wasn't getting a lot of lead time after doing them.

So hydrogen kept popping up popping more and more and more. That really frustrated me because my hydrogen water machine wasn't having any benefit. "How do I even know there's hydrogen in here?" So I tested it. There was no hydrogen. I then took the machine in for a deep clean. I was told maybe it's calcified.

JM: Before we go there, I just want to go more into your background. Because a lot of people will have debilitating health challenges that you just described. But very few of them are going to go to PubMed, review the literature, understand the literature and then take implementation on that.

Why don't you tell us a little bit about your background, scientific background? Because you're a pretty astute reviewer of the literature.

AT: Yeah. I don't have any formal education. But I probably read at least eight hours a day. I innovated on another device previously with a former partner. We modified these breathalyzer vending machines that use platinum fuel cell that is police grade and had the engineers switch them so they can be disposable instead of needing to be taken in for calibration. Disposing is cheaper than calibration.

But all my past physicists – I've kind of have been self-employed since I was a teenager really, which have left me a lot of free time. I just read, read, read my entire life. I'm just a very curious person. Even now, reviewing the literature. I'm writing a systematic review on the hydrogen and metabolic conditions with a professor who encouraged me to write it with him, that he'd write it with me and make sure I'm doing everything properly. I majored in North American University. Just this last weekend alone, I spent over 30 hours, from Friday to Sunday, going through the actual data. It involves analysis. So that's what kind of makes me tick.

JM: That's an unusual characteristic. But it's actually what's required. If you're going to make innovations, go ahead. I mean you can get a degree. You can get multiple Ph. Ds. But ultimately, you need to be a perpetual student and be diligent and continue to review the literature and understand what these new innovations are, because science marches on. If you don't keep current, you're going to fall behind.

AT: Exactly. That's why when you rewatch a movie after 10 years or reread a good book, you might have a completely different perspective on what you watch or what you wrote based on new knowledge you have. Also important, I've surrounded myself with a lot of good people. My founding partner is a Ph.D. medicinal chemist. I had him review all my early work to make sure I wasn't making any critical errors.

I used a bit of a Ray Kurzweilian strategy when I was developing the tablets. I found experts. I found engineers. I found pharmaceutical formulation firms. I contracted a physicist, a chemist and biochemist. I tasked myself with learning enough in every area that they could simplify and only think about what concerns them because – the same thing with manufacturing, I could do the same – everyone will overweigh what their challenge is on their keyhole, and then it makes communication very hard. Like the physicist might not consider – the chemist, who might not consider what you need to do to make millions of tablets rather than one, right? That's kind of what I did. I just quarterback the whole thing. I never –

JM: So now we've got your history. I interrupted you in the process of describing what you're doing for the water machine. But I want to insert another piece of information that I neglected to mention initially. It's that you are the inventor, the original developer of the molecular hydrogen tablet. You're the genius who put this thing together. Many people tried and failed, including many large companies, but you succeeded.

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

AT: Eventually. I failed a couple thousand times.

JM: Yeah, yeah. It's okay. Like Edison. But eventually you succeeded. You did it, where no other company or individual was able to do it. You've got a really exciting journey to tell. I interrupted you right as you were starting to tell it. But I wanted to provide a broader framework so people could put it in proper perspective. Before you start diving deep into the story, let us know about these molecular hydrogen generators or water generators. That was really the primary and only way that you can get the molecular hydrogen initially, at least conventionally available.

AT: Yeah.

JM: Pick up the story there, okay?

AT: Yeah. One of the big concerns about these water ionizers that purport to make hydrogen as – They don't work if you don't have TDS in the water for conductivity, so they won't dissolve hydrogen.

JM: TDS is total dissolved solids, things like minerals. Reverse osmosis or distilled water wouldn't work.

AT: Yeah. Exactly. It won't in these ionizer devices. Now if you do have TDS, then the plates that are used to split the water, they start calcifying, getting a mineral layer over the plates. Now what ends up happening is they'll still make hydrogen, but it doesn't dissolve because the bubbles are too big, right? It'll still make the same amount of hydrogen, but it's just in and out. It doesn't dissolve in the water.

In a lab, when they're using pure gas to dissolve through a beaker, it might take half an hour of bubbling. Liters and liters of hydrogen to even get to 1.6 parts per million (ppm), to get enough to dissolve it. But the smaller in bubbles you go, the easier it is to dissolve. What I figured out is when you even go into the low nano range, you can quasi-dissolve this cloud of gas that neither fully dissolves without accompanying pressure, but it also doesn't escape. So you can get in a half a liter, 8 to 10 ppm, right? Instead of the 0.1 that a lot of these ionizers are giving you.

JM: 0.1, literally almost 100 times lower.

AT: Yeah. No. Absolutely. This is critical because a lot of people look at the rodent research. They fail to properly convert – And even researchers failed to properly convert just how much more hydrogen mice are consuming per body weight than humans. Because when you take a 25 gram mouse and you convert it to an 80-kilogram person – so that's 176 pounds for American viewers, that's the average weight of the American – that person would need to drink the equivalent of 12.8 liters of water a day to get the same amount that that mouse drinks.

So consequentially, it's critical because you need to raise your cellular concentrations of hydrogen. If you're only drinking half a liter or a liter a day, then you need to up the concentration to get that proper dosage. That's not even going into looking at a lot of other molecules. The rule of thumb from ecology is you need about 12x dose in humans as mice, right?

JM: That's a good piece of information, especially for anyone who's a biohacker out there and in longevity research. Because there are so many of these studies that are only done on mice or rodents. Thank you for that translation variable or constant. About 12 times.

AT: It's why a lot of molecules out there – They don't say exactly what would be in a mouse, like cyanide. Glucoside has shown really good brown adipose tissue activation, but you need grams a day in a person. As hypothesized to cure obesity in a mouse, you'd need something like 34 grams in a human person per day. That's even ignoring the differences in bioenergetics between mice and humans.

JM: Sure.

AT: It's possibly the farthest away that we are from mice. Well, that would cost 1,000 dollars a month, right? If you're buying just a pound of wholesale. It's just crazy, not useable. Even with the NAD+ precursors, I think most of them would need to translate from the rodent literature like 2 grams a day.

JM: Yeah, yeah. I don't want to go down that path. I love that, but we've got so much to talk about hydrogen now. Why don't you continue the story? Maybe even tell us the differences between drinking this low-concentration hydrogen water as opposed to taking these higher doses, and the way that hydrogen works. Because it appears that it's best taken cyclically or pulsed. That if you take it continuously, the effect seems to dissipate or actually not be there at all.

AT: Exactly. We're producing upwards of 10 liters of hydrogen gas a day through bacteria breaking down carbohydrates through our digestive system. How can taking such a small amount of hydrogen gas improve things? When you look at cellular response to hydrogen versus inhalation – or drinking hydrogen water or inhalation versus what blood constant is, it can double cellular concentration, drinking a lot of hydrogen water for about a 5-minute peak. That's when you see all these changes in cell signal and gene expression.

Most of what hydrogen does is indirect response from altered cell signaling and changes in gene expression. We simply need that pulsed dose to alter all these things. And then some of the basic science of the rodent studies and neutral data, when they've given continuous gas administration and just constantly raised the cellular concentration, it's had no benefit, even at a much higher dose. Whereas in pulsed, effect is good.

JM: That's not intuitive. You wouldn't think that would be the case. This is really an important distinction to understand.

AT: Yeah. It clearly is. I just ran a study that just actually came out two days ago. They were trying to replicate the lowered maximal heart rate study that used the tablets. That was a 10-mg dosage of hydrogen before exercise. They used a water ionizer, measured it with a TRUSTLEX meter that actually doesn't measure hydrogen unless cued by ph. For instance, we're getting 0.6 mg of hydrogen, opposed to 10. It's a massive difference. It's 117, the amount of hydrogen. That is ignoring the inaccuracy of the device that they used.

It could have actually been 0.3 mg, 130th or less. Well, they found that in the study, and no markers. And I wouldn't expect there to be, right? You see, again, our study on NAFLD, non-alcoholic fatty liver disease, when you extrapolate what worked and what didn't work – Tyler LeBaron was part of our early study on NAFLD in mice. 0.3 ppm had no effect, but 0.8 ppm had a prominent effect. When you do the conversion to 1 liter a day, a human would need about 10 mg of hydrogen to see the results if it's a direct comparison.

JM: Okay. Let's just stop here, because there's a little bit of confusion because you're giving us an actual quantity, 10 mg. But normally, we look at hydrogen as parts per million. So what does the 10 mg convert to in parts per million?

AT: Depends on how much water it's in. Basically, parts per million is a concentration. The milligram would be the dosage. [You have to] know what the dosage you're getting acutely is. With the tablets, we come to get 8 to 10 ppm, which translates to milligrams per liter (mg/L), right?

JM: If you took a liter of that concentration, you would get 8 to 10 mg.

AT: If you use two tablets, right? Because you're designed for about half a liter.

JM: Two tablets per half a liter should give you that.

AT: One tablet per half a liter will give you.

JM: One tablet. So you do two tablets. You do a whole liter at once or you would do half a liter twice a day?

AT: They've done it twice a day. I find it more effective to do it all at once. But a lot of people can't drink that much water. I mean that's why we also need to consider these things because the mice in these studies are just drinking water all day long.

JM: Yeah. Totally different.

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

AT: Compared to a human, a human should get, the average woman, about 2.7 liters of water a day and the average man 3.7 liters a day for 3.2 average. So a mouse would drink about 4 times more, exactly four times more than the average person. But most people aren't drinking that much, right?

JM: Yeah.

AT: They're certainly not drinking hydrogen water for all their water consumption.

JM: Just an important tangent and as a question I have for you, if you put the tablets in – wasn't it a half a liter water? Say you put those two tablets in, ideally one tablet is supposed to go in half

a liter of water. What if you put the two tablets in a half liter of water, would you still get the same amount or no? Because you can't dissolve it at a higher concentration?

AT: Yeah. You're getting a higher concentration but a lower dose than if you've done them separately. Because the effects aren't linear. When I put two in half a liter opposed to one, I tend to measure about 15, maybe 16 ppm.

JM: Okay. So pretty close to what you would?

AT: Yeah. I mean, you get about 50% more instead of doubling of that by doubling it in. It's what I tend to do when I take the water, because I want that higher pulse.

JM: So you're doing it once a day? That's what I concluded too. Once a day is more effective, because you get that strong pulse rather than twice a day.

AT: Exactly. I get a pick me up. It works better for me than caffeine. I'm a responder, which is, again, something really interesting. We're looking through the literature, as responders or as non-responders, and even some of the raw data that some of the professors have sent me. There pretty clearly looks to be responders to H_2 and non-responders. But the non-responders are still getting positive effects, just not as prominently. The responders in some of these studies and metabolic studies, they're having crazy benefits, right? But we see that. That's the way everything's going.

Even the drug industry's going to look for, "What was your genotype?" Right? "Are you going to respond to this? Aren't you going to respond to this?" I think we're going to be having to reevaluate a lot of what is out there currently as we're getting better at genetic testing, right? To know, "Should this be used for this person?"

JM: We got into a tangent, admittedly an important one, but we still never finished your story about breaking down this ionizing water machine and then you eventually developing the tablets.

AT: When I tested this ionizer, I was actually getting a 0.03.

JM: Virtually nothing.

AT: Virtually nothing, right? I sort of was reading a lot of the studies. They're using magnesium in different ways. I tried some magnesium sticks. It wasn't working. I was concerned about getting too much magnesium. I just started looking to make powders and tablets and sort of pressing into these tablets. At first, the magnesium was really hard to get. I had to go through the Department of Defense (DOD) and the state department to be compliant in eight different government agencies to use the magnesium. We were able to –

JM: This is metallic magnesium.

AT: Yeah.

JM: What is metallic magnesium? For those who aren't familiar with it.

AT: Element. Usually when you're buying a magnesium, it's a salt, it's combined with different molecules. This is reactive. It's non-ionic, elemental magnesium. It's what is used in fireworks. It's what is used in a lot of explosives. It burns really hot. It's the white in fireworks. It's very hazardous to handle in production. We have very, very controlled production. But it's a very safe tablet. So our hydrogen tablet is not HAZMAT (hazardous material). It's not explosive. It's not flammable. But it will split the hydrogen off your water.

JM: And sort of an aside, the tablet you developed for us, which took a few years, is not only not hazardous and HAZMAT, but it's GRAS, generally recognized as safe. It's the first one to ever do that.

AT: It's a new dietary ingredient, so it's the same submission. But in 2016, they changed it from a GRAS submission to a new dietary ingredient notification (NDIN) before supplements were – Either way, the U.S. Food and Drug Administration (FDA) just kind of shuffled things and said, "Supplements have to do an NDIN process now. Foods have to do a GRAS process." We're in the dietary ingredient status, so we've got no objection from the FDA. We submitted dozens of pages of our chemistry, all of our manufacturing information, everything we do, our safety data and chemical analyses that we've done. It was just a massive submission. They turned around and said that it basically looks good.

FDA never approve supplements, but they fail to reject some of them. It's very important for me to NDIN for compliance because now a drug company can't call hydrogen medicine. Just add another molecule along with it called a drug, so the tablets will always be protected. So they'll always be free to the consumers, right?

JM: Which means a lower cost to them. We have wanted to sell molecular hydrogen years ago but because this substantiation hasn't been done yet and haven't been approved from the FDA, we chose not to do it until it was completed.

AT: Absolutely. I mean we've shored everything up, like we're using a very special pharmaceutical grade of magnesium that's ground to very specific ways for us to get the nano bubbles that we're doing. When I first started tinkering around, I had some of it tested. I was getting magnesium in from like Russia and China that was being mislabeled and sent to me. I later found they were illegal for export from both places. It's heavily controlled in the U.S. due to shipment. Just to get it out to Canada, it would take about an eight-month process with the state department with background checks, facility checks and in-person interviews and everything, to make sure I had a legitimate purpose for this stuff. While a lot of other people are trying to use it, they're bringing in these stuff from China and various places.

JM: These other people, there are other people who are manufacturing hydrogen tablets?

AT: Yeah. I mean, most of them are going under it seems like, right? Because their products' inferior, it's super deep. It's hard to do. There was another guy making tablets. He didn't go down any of these processes. I don't know the accuracy of this, but I've been told from people close to

him that he was buying from a fireworks reseller, buying it. I saw one COA of his where he was not compliant in lead content.

JM: And COA is certificate of analysis.

AT: Yeah. We had to show everything. I mean we're compliant in our heavy metals. It's something like you need 16 tablets a day to hit the threshold for California Proposition 65, which is about 10 times stricter than the pharmaceutical regulations on it, which is even several times stricter than some regulations. We have such low levels of contaminants in our product.

JM: Yeah. There's like – I guess there may be some. Never say never. But there's a pretty rare indication for anyone to ever go to 16 tablets a day. I mean that's just –

AT: No. Again, that just would come with a warning in California. It's still something like one-tenth as low as what's allowed in pharmaceuticals, which is more than what's allowed in supplements. For supplement regulations, I think you could take something like a couple of hundred tablets a day.

JM: Yeah.

AT: But the FDA, it's such low amounts. But we went to great lengths to ensure purity on everything and to ensure the framework was in place before we started doing everything, which again is why we're pursuing so much research with public teams under no publication agreement. We have five publications already in three years. We have 200 with you. We have seven more that are underway and six in the planning stage that are finishing up their ethics approvals and protocols. And we have four pretty prominent universities conducting rodent trials using our tablets.

In total, we're now working with nine or ten public universities around the world to further the research and assist in any way we can, because we want to know more about how it works, what dose should be used and when it should be taken. The data is starting to come out. Things are definitely emerging. Higher dose, higher concentration and intermittent pulse seems to be the best for humans.

JM: Let's go back to the transition or your journey of health recovery and tell us what you did to finally actually restore your health and how you did it with molecular hydrogen.

AT: Yeah. I mean making the tablets, I started drinking them. It was hard to get them to be made properly. When I was getting something like 3 ppm in half a liter with my first hand-pressed tablets, my shoulder completely unfroze. It just went crazy. My hip did it too, right?

[-----30:00-----]

I went from training in jiu-jitsu and I was able to touch my ankle to my face with ease to I couldn't go into a butterfly position on the ground in a matter of a couple of months, because the arthritis in my hip seized everything in. It loosened up my hip. It loosened up my shoulder. I just did a

couple of controls. I stopped taking the relatively high-dose hydrogen water. I was taking about 4 liters of hydrogen water a day.

JM: How were you drinking it? Continuously or were you pulsing it back then?

AT: I was drinking it three times a day, I think, if my memory serves. Yeah, no. I think I was drinking 3 liters. I think I was drinking 1 liter in the morning, 1 liter in the afternoon and 1 liter before bed. I had these thermoses. And then I went in and I started getting a little bit more hardcore. I started picking the pressure up and I was getting close to 5 ppm in taking this dose. But I was needing to put the thermoses in vice grips to remove the caps because they were getting knocked off the threads. I was actually – That was my first run-in with, "Okay. I've got to have safety control here," because one of my thermoses blew up in my fridge.

JM: Yeah. Let's go into that because this molecular hydrogen actually converts to gas, which increases the pressure. But also, the reason you had that cap on there, as I understand, the first tablet, in fact maybe most of the tablets out there, require that you do it in a closed container, otherwise the gas will escape. And then you developed something that doesn't require that. Why don't you provide that distinction?

AT: Absolutely. I think that's really what sets us apart. That's the basis of most of our IP and what we've done. And it was an accident. We didn't do it on purpose. It was actually – We spent three months trying to make it not happen because our initial goal was to get 3 to 4 ppm in half a liter in under five minutes in a sealed container. So we were using the same principles to do this, as opposed to using an open cup. But what was happening is every time we'd unseal these fast-reacting tablets, the water went white. This would test very high and return down very quickly. The half-life didn't make any sense. We're beating our heads against the wall.

After a few months, it just dawned on me, "Why are we fighting this? Getting higher levels by doing this? Then we were aiming for oversaturated." "I wonder what the results are. I wonder how we'd do in an open cup." It was higher. It was under two minutes at that time. A quote I really liked from Isaac Asimov that most people think that discovery isn't science if not with "Eureka, I've done it." But new exciting discoveries often are just, "Huh. That's funny." If something doesn't make sense, right? So it really didn't make sense. And then finally when we did it in the open cup and we replicated it over and over again, it still didn't make sense. I contacted Tyler LeBaron. I said what we're working on. He said, "I don't believe you. Show me." I put him online.

JM: Tyler is the perpetual skeptic. I love that about him.

AT: Yeah. No. It's great. I mean I'm a skeptic by nature too, right? But I'm very easily excited by things. But then I try reining myself in and say, "What else could be going on there?" Tyler failed to falsify what we were doing. He did multiple tests. He took them into testing in Japan and China, different conferences and apparatuses. He asked me to do some tests and I did it. I've been through the same thing with Randy Shark who runs H2 Sciences. Now he's going to be running H2 Analytics, which went well and was granted permission from the International Hydrogen Standards Association (IHSA) to give the IHSA-certified as containing at least the minimum threshold of hydrogen. He was as or more skeptical than Tyler, but he did all these reports, which

now I find paying him to do new ones. But he did the first ones for free because he just wanted to falsify what I was doing. But he failed to falsify what we're doing. Now, as we're getting more data, we're doing gas chromatography, we're doing all these different things, every report – and there's a little bit of variance between the reports – but they're all indicating between kind of like 8 to 11 ppm in half a liter. As more and more –

JM: This is with one tablet?

AT: With one tablet. Yeah. So when we kind of figured that out, it just changed everything in our research and development (R&D). It just completely – And luckily, our goal was pretty similar, so we didn't have to change a lot. But we did have to go back to basically the ground floor to restart. To get our first projection, it needs to be sealed in a sealed container. I was getting about 3 ppm about five to 10 minutes type thing, depending on water source and temperature. That was 2,000 failed formula attempts and 15 failed scale-ups. We got the chemistry to do it right in a hand-pressed tablet in three weeks. Thanks to my partner, Dr. Richard Holland.

This is where everyone else's fail, in going from the bench test, pressing a few tablets with one, even a hundred, even a thousand, to being able to make millions, so that there can be enough for the consumers. So much changes when you start having to use different excipients to even run properly on the machine, it changes the delicate chemistry in what's going on, right? Because magnesium doesn't react with water without kinetics. You put magnesium in water, it forms a protective layer of magnesium oxide. It isn't water-soluble. You're going to get no hydrogen.

What we're doing to get the – We're basically forcing this reaction happen. But by using all these other excipients that other companies are able to really use all the time in manufacturing, it stops a reaction from happening. It cancels out all the coaxing that you're doing. So that's what 2,000 failed changes in formulation, 15 failed scale-up attempts to get [to] tablet one.

Now, we've now gone through thousands of formula adjustments to refine the process, to be able to do it easier, to be able to scale-up, get more hydrogen out of the tablet and have it better literally makes an appearance for consumers. It's been thousands and thousands of adjustments and failures and learning from that knowledge. A lot of people just aren't that obsessed. Even a lot of big companies, they try a few things for a few month's project. They might have 10 people working on it for a few months. But this took years of failure, failure, failure and deep thought from a lot of different people that I was leaning on to get there.

JM: No. That's great. And these attempts, multiple or thousands of failures, all occurred after you received the benefit. So that's what I would imagine was the primary motivation and a catalyst for you to continue your endeavors.

AT: Exactly. When I saw the benefits, I started hand-pressing tablets and giving them to others, family members who had different ailments, and friends. I actually have a lot of friends with various cares and inquiries. It actually spread like wildfire because people were talking about it. I'm hand-pressing these tablets. I'm getting friends of friends calling me saying, "I heard of this stuff." "I just tore this. Can you please make some for me?" I'm there. I destroyed my stone table hammering these single tablets and my modified single pill press that I made.

JM: These were the pills that required a closed container, I would assume, right?

AT: Yeah. These were in a closed container. That was at about 3 ppm. People were consuming two a day in half a liter. They were getting milligrams.

JM: Okay. Is it true now that your company has the only tablet in the market that gets to the 8, 9, 10 and 11 mg/L?

AT: Yeah. Nobody comes close.

JM: No other company does.

[-----40:00-----]

AT: No. The closest – There's a company in Japan that uses pressure. They claim that they can get to 7 ppm in half a liter. But it takes about eight hours. Rather than use magnesium, which upwards of 90% of North Americans are deficient in, the byproduct is a highly available magnesium source because what happens in our reaction is it leaves free magnesium ions. That's what you want in your body.

JM: Yeah. It's not soft, like magnesium threonate, citrate and malate. It's magnesium ions, which just goes straight in to where it's needed.

AT: Yeah.

JM: The ultimate. It's like 80 mg per tablet?

AT: Yeah.

JM: That is real magnesium. Almost any other salt, you have to do the calculations to figure what the elemental magnesium is at, but this is 80 mg elemental.

AT: Your body has to do work in breaking it apart. That's what magnesium oxide is about 4% bioavailable in the average person, but could be 0%, especially in the elderly who have compromised gastric acids. That's because your body has to break apart the oxide from the magnesium. Well, our reaction does that. It just leaves the magnesium how you need it, right? That's the big benefit of ours. This Japanese technology that – I have to do a report that it's more like 5, but it can get up to 7 ppm per half liter. Well, they're using elemental aluminum.

JM: Let's put some aluminum ions in your body and let's see what that does for Alzheimer's.

AT: Yeah. Exactly. It's crazy. They're running these scare campaigns against magnesium throughout Japan. They're trying to stop people from using magnesium. They're calling it dangerous and not sanitary, but they're using aluminum, which just blows me away. That's going on there. They're the only ones who get close to us. That's about that.

JM: That's not a competitor because why would anyone, any rational human being, choose to use aluminum over magnesium? That just doesn't make sense.

AT: It's cheaper.

JM: Yeah, well, forget the cost. It's just the health benefits we're talking about. The cost isn't really that significant, considering you could buy hydrogen gas and breathe it, which is another way to do it under pressure. There are so many other ways you can get it.

Why don't we take a tangent here and talk about the other ways that people can get the benefits of molecular hydrogen? Your tablet certainly isn't the only one out there. I happen to strongly believe that it is the absolute best and finest way to obtain this, and certainly the easiest, most convenient and probably the most cost-effective. To me, there's no other rational solution. But why don't you discuss what else is available? What other people are using?

AT: Basically, there are a lot of clinical trials that use a saline. That's not practical, to hook people up to an IV every day. Inhalation is a popular method. I have been developing an inhalation unit to hit specs. One issue with inhalation is – And we need a lot of data on this. The only data we have in one example is that you roughly eat 100 times more hydrogen gas when inhaled to have similar benefits as when dissolved in water. But in the same review, it talks about how different genes respond only to water or favorably a gas or seem to respond the same to any administration method. Maybe in one condition, you need 10 times more inhaled gas by volume, but in another condition maybe you need 1 million. We don't know. That's years in our future. We're going to be developing these.

I'm developing this inhalation unit because I don't like the ones that are currently on the market. There's one using H_2 at 0.99%. Now, above 70% hydrogen isn't explosive or flammable, But they're going through a cannula, right? What if there's a leak in the hose or anything? Now that hydrogen's diffusing through the air around the person, well the person sparks a cigarette, right? Anything that can happen will happen if there are enough instances of it. The saying, when you think of infinity, if you put a monkey on a typewriter, in infinity, at some point that monkey will basically write out all of Shakespeare's pieces, spelling word, perfect in chronological order. Because anything that's possible will happen in infinity. You get millions of people on these pure gas, hydrogen inhalers, the time will come that one will explode, alright? And they'd die.

Even more dangerous is when people use hydroxyl machines, which is two-parts hydrogen and one-part oxygen. Well, 33% oxygen and 67% hydrogen, that's an explosive. People are using these right now. They're getting an adequate dosage of hydrogen, probably getting therapeutic effects. But again, if millions of people are doing that, people will die. It's dangerous.

Then there are all the ones that are on the safe level that don't have proper flow rights. Because when you give animal studies and even some of the human studies, when it's 4% gas? Well, the actual inhales 5 milliliters (mg) of gas per minute, so 6.5 liters. If the flow range is at 4% at 1 liter, you're at one-fifteenth of the required dosage and concentration because you're bringing the rest through breathing. We've been des--igning our unit to hit our specs that's safe and will give them

the proper dosage. I suspect that it will be coming. Once this is out in the market, you can change your dosing. Maybe one day use inhalation, the other day you drink water. We're also looking for other trials. We have a case study under you for bathing in hydrogen water, topically. For things like soft tissue injury, it is far more effective.

JM: Okay. Great. It's exciting. I didn't know that you were working on an inhalation system that is really useful. Why don't you – I'm still curious as to the final resolution of your initial health challenges and what eventually got your c-reactive protein (CRP) – I'm assuming it's below 1 now, and then how long it took you to recover your health and what your level of health is today.

AT: In a 4 to 8 window, I was above 30 to under 1. That's when actually the arthritis hit. It seems that my CRP docked. It was days my shoulder was frozen. But my CRP wasn't elevated. My health actually got worst as I was working out 100 plus hours a week, sleeping three, four or five hours at night. My health was the worst probably last January. But on top of hydrogen, I just started sleeping better. It was interesting. Hydrogen was likely protecting me because I was 40 pounds heavier than I was right now. I gained over 90 pounds from when I had my injuries.

JM: That was visceral fat most likely.

AT: Yeah. I mean, I'd lost muscle mass, right? And gained that much weight. But my cholesterol was normal. My triglycerides were normal. My fasting blood glucose was normal. My blood pressure was normal at the time, but with the changed guidelines, it was in the pre-hypertension stage back then, but just doing slight modifications now, I've dropped about 40 of the 90 pounds I gained. I'm not able to work out like I used to, but I'm working on it a little bit every day. I'm going for a walk every day. I'm doing several hundred body squats a day, just working out my core. I can't do anything upper body.

I just had shoulder surgery and I probably need another one because it looks like I tore my rotator cuff in rehab post-surgery for my torn labrum, and I'm swollen from arthritis. I'm dealing with that. But I'm also fasting. We talked about your fasting protocol. I've been doing that for months. Actually, I fast 43 to 48 hours a week every week. Every fourth, I'm pushing it to 72.

JM: Okay. What have you noticed by doing that?

AT: I dropped 40 pounds from February to August. I've stayed pretty constant since then. I'm actually going to play around with my fasting a bit more because fasting isn't bugging me. I tried 48-hour ones this week. I didn't get hungry in any three. Despite going on that much deficit, I didn't lose a pound this week doing three days.

JM: Well, it is really going to be great for you to do this. I would never recommend that amount of fasting for someone who is in normal body weight or below body weight, because that's a prescription for disaster. But for someone who has weight to lose, like you, because you've had an injury or a health challenge, that is magnificent. You need to continue that. But are you doing time-restricted eating on the days that you are eating?

[-----50:00-----]

AT: Yeah.

JM: Are you restricting your eating window for two to three hours or four hours?

AT: Yeah. It's between two to four hours, depending on the day.

JM: Perfect. You've got it nailed. Your body's giving you the good feedback. Your sleeping's improving, you're losing the weight. You're regaining your health. We'll have to talk offline about some rehab exercises, like the blood flow restriction training for your shoulders, which I think will be really, really helpful.

AT: Interestingly for you on all these stuff, my metabolism has recovered. I'm actually consuming more calories now than I was at 265 or 225.

JM: So how much calories a day are you having?

AT: Above 3,500.

JM: Yeah. How tall are you? You're like 6'1.

AT: I'm 5'11.

JM: Okay.

AT: I've got quite a bit of muscle mass on me. But at 265, I was eating 2,200. But I was pretty metabolically impaired. Now, even when I have like a cheat meal and maybe a little bit too much red wine, my fasting blood glucose doesn't budge between about 4.1 to 4.3 millimoles a liter (mmol/L), when I get up in the morning, regardless if I'm on a long fast or I had a couple bowls and wine the night before. So my glucose is stabilized, rock hard.

JM: Yeah. That's a great index that almost anyone can use. You can get these meters for as low as 7 dollars, and the strips, if you buy them in bulk, for 35 cents. You don't have to go to the doctor. You can monitor yourself. And at a high glucose, and most of the people here are not using millimoles, although that technically is a more accurate way, but anything over 100, three-digit, 100 mg/dL of glucose is way too high. You've got to do some serious reevaluation of what your program is.

AT: I was at about 95. So it's kind of like an upper safe, which with the studies we have on NAFLD – I think it was submitted last week, maybe this week on Medicine – metabolic syndrome on the 60 participants. With all this data and all the data we have on metabolic syndrome, I think I was being protected, because gaining 90 pounds in that amount of time, I was not watching what I ate. I was working 100 hours plus a week. I was not sleeping properly. I was just realizing I hadn't eaten yet in the day and then ordering pizza and I'll bring up all the point –

JM: Alex, that was not intentional because I didn't know this part of your story. But you provide great illustration and example of the fallacy of the magic bullet. There's no question that molecular hydrogen is one of the best supplements I have ever encountered in my life. I take it every day. I think I'll take it until I pass. But it's not a magic bullet. It needs to be integrated with other elements of a healthy lifestyle. You weren't doing those. Now you are. Now you're doing the fasting. Now you're doing the time-restricted eating.

You're actually making wiser choices in the types of foods, your macros and your percentage of fats versus carbohydrates. Your whole body is responding to it. But fortunately, it seems like the molecular hydrogen did save you from damage despite those unhealthy habits. We don't recommend anyone taking it while they're still having unhealthy habits. They need to do everything at once.

AT: Exactly. That's actually what excites me the most about hydrogen. It is, one, it's shown to have this protective effect, this rescuing effect in the data. It shows that the more damage someone has typically, the more prominent hydrogen is working to bring them back to homeostatic function. But on top of that, what excites me the most is hydrogen is shown not just to cancel out and mitigate the stresses from other forms of hormesis because it seems to be a form of hormesis itself. It seems to potentially, like exercise. It works similar to exercise in very well controlled studies to actually increase the acute stress, which is how exercise works to make us healthier. But then, it comes to this rescuing effect to basically bring recovery faster, right?

In this really controlled rat study, the rats had higher stress, were swimming longer. But as their stress spiked more, their redox regulated faster and their inflammation was blunted. A really cool article I just read this weekend, it's under press right now. It's in press right now, so it should be online in a week or two. A week of loading on hydrogen, followed by some, I think they were treadmill tests and sprint tests, showed a significant – or they might have been bikes. I can't recall. I read two studies that just came out in the weekend. It significantly improved exercise performance. But what was interesting is it significantly lowered insulin-like growth factor 1 (IGF-1), whereas exercise raises IGF-1. They performed better, but they had IGF-1 lowered. This is irrelevant in longevity, I think.

JM: Well, there's a lot of confusion on that because it depends on where the IGF-1 is being measured. If it's in the plasma, which was typically measured as one thing. We know elevated IGF-1 and a plasma will inhibit autophagy and has been shown to be counterproductive in longevity. But exercise, as you mentioned, increases IGF-1, but it increases it in the muscle. That doesn't go out into the plasma. That's where it needs to be. It needs to work locally. The IGF-1 produced by the liver typically does not impact that, the IGF in the muscle. There are two different – I haven't reviewed the studies, so I would be cautious about reviewing them from that perspective.

AT: The professor is publishing a few more questions about it. I haven't had the chance to talk to him yet. But there are a lot of interesting things we've seen in hydrogen.

JM: Yeah. But before we go there, I want you to go back to the basics. Because you've written this comprehensive review that will be published in the future. You're probably one of the leading

experts out there next to Tyler. To me, it's fascinating the way these things work. You mentioned it works by hormesis. There's a delayed impact. If you're going to go through an oxidative stress, like basically flying domestically across the country, you're not going to want to take it as long as you jump on the plane. You want to take it a few hours before. That's because it has to go through this process where it actually activates the genes and the DNA to make your endogenous antioxidants, like catalase, superoxide dismutase and glutathione. Why don't you walk us through that process?

AT: Yeah. I was going to say probably not even just a few hours before. It's probably best to load for a week before if you're not doing–

JM: Oh, really? I was not aware of that.

AT: Say, for instance, for my surgery, what I actually did is a month before, I did my cycle off. Because every three to six months, I'll stop taking hydrogen and let all my joints seize and deprive my body of the exogenous hydrogen. And then I change my dosing protocol to keep my body guessing. It seems to kick things into gear. It seems that in the past, when I had the same dose of protocol for a year, that things started seizing back up again.

JM: Interesting.

AT: Hydrogen's not working now, but then when I get a wash-out period and changed it, because I was taking a bit more exercise at that point, I recovered again. Everything sort of moved things back up.

JM: Yeah. So you have a great biological parameter to follow. There's not really a test for it, but you're listening to your body and seeing what the benefits are.

AT: And I've been telling most people to do the same. Family members, again, with various forms of arthritis and everything have all recorded similar: that it wasn't really working, but we'll let it wash out and they changed out dose and timing, that they got the benefits back. These are a lot of people who are on it for four years. They just were stalking seen benefits for it. But it seems that when you change up, you do a wash-out every few months, six months, and then you change how you take it, that it seems to come back into that rescuing of that.

JM: What's the change in how you're taking it? Are you increasing concentration or the frequency? What variables are you shifting?

AT: Every time I change it, sometimes I'll do it twice a day. Sometimes, like some cycles, I'll do it twice a day, even three times a day, I've tried. I seem to get the similar benefits. I'll go and change and have a higher concentration or a lower dosage. The last data – I can't recommend this for people, because it's a lot of magnesium and a lot of hydrogen. I wouldn't recommend starting with this. But I dropped five or six tablets in 600 or 700 mL and chug it. Then I change the protocol a while –

JM: A little about half a liter.

AT: Yeah.

JM: Normally, you would just put one, but you're putting five or six.

AT: Yeah. To get a big spike in concentration.

JM: I'm just curious, what do you think the milligrams were in that half a liter with five or six tablets? What's your guess?

AT: I was doing more than half a liter, like 600 or 700 milliliters, in the biggest mug I've had, probably close to 20 mg. It's a pretty high dose.

JM: Okay. Big dose, big dose.

[-----01:00:00-----]

AT: But then other times, I've switched and I exercise five or six days a week and I was only taking them on days I exercise, five minutes before I exercise, which, anabolically is when we see the biggest benefit for exercise. You'd want to take it five minutes.

JM: Really? It's five minutes before? It's not an hour or two before?

AT: Yeah. Immediately before exercise. That's when it seems to have the biggest impact, especially on heart rate and modifying heart rate. That's interesting. Now, I'm on a protocol where I have a 30- to 60-minute bath once a week. I'm actually doing a hybrid. The day I take a bath, I don't drink the water. In days I'm not exercising, I do it in the morning. In days that I have an exercise planned or a long walk planned or something like that, more than just the body squats, I get up and do it about once every hour or do 40 or 50 body squats just to keep my body moving. I won't take it in the morning. I'll do it right before I do that. So I'm on a hybrid protocol right now. I've been doing it about two months.

JM: So I'm curious about the baths. How many tablets are you putting in there and how long does the hydrogen stay in the nano bubbles in the bath? I would have thought that it would have escaped into the air within a few minutes.

AT: We know that topically, you need to lower concentration. I'm using a lot of tablets. I'm using – We've designed actually a bath tablet. It's a little bit bigger.

JM: Okay.

AT: It's the size of three. I'm using those. I'm using quite a number of them. I wouldn't recommend people use that amount every day or anything if they're having a bath every day. Putting in about six of these bath tablets into a 60-liter bath tub seems to keep it at about 0.5 ppm. But in the literature, topical seems to work better for these skin issues and soft tissue injuries. Because you have to remember it's working by getting and raising the cellular concentration. If

you're drinking it or inhaling it, it's diffusing through the whole body. If you have a bruised up leg or something and you put it in the water, submerge in it, you're getting actually a lot higher concentration from the measurement.

JM: Tissue. Sure.

AT: Into that acute area. Into that acute tissue. I'm doing that. It's doing 500 to 600 body squats every day, my legs get pretty stiff. By the end of the week, my hips do too. I've got arthritis in my left hip. I've got arthritis in both knees too. But after this bath, I'm limber.

JM: Interesting. We'll have to get some of the bath tablets on our store. I wasn't even aware that was even an option.

AT: They're still kind of in dev. They're not being marketed. I've made them – We have a case study under review related to ankle therapy for a soccer player. It's almost like magic, right? But that was a high dose. It was the equivalent of a tablet per half a liter in a foot bath. We have a full RCT, randomized controlled trial, comparing topical hydrogen to rest, ice compression and elevation (RICE) protocol in 20 pro soccer players, as they were getting greater ankle therapies, it's ongoing. The professors running that research, it looks likely, I mean from the case studies anyways, because they did case studies on two participants, and RICE protocol does not have those effects. We'll know about – It's something pretty good.

JM: So when you're drinking, you put the tablet one or two tablets in the water, drinking orally. How quickly should you drink it? I've been instructing people to hold the glass up and see when the tablets completely dissolve, because it's variable. It's primarily dependent on the temperature of the water. It could be one minute and a half or two minutes. It could be a minute. It really depends.

AT: If someone wants warm water?

JM: Yeah, yeah. Warm water. It could be in 30 seconds. Assuming that the tablets are all dissolved, is that the right way to do it? How long is the hydrogen stable in the water to drink it?

AT: You want to drink it as fast as possible.

JM: That's what I thought. Yeah.

AT: What we're doing is a novel way to get around something called Henry's Law, which describes how much gas can saturate it and contain very much suppression.

JM: Yeah. Definitely go there. Maybe take this tangent now. Because normally, you can only go to less than 2 mg/L with a normal diffusion of hydrogen. I mean you've got to work around with these tablets.

AT: Yeah. That's the SATP, the standard atmosphere temperature and pressure, that we have in our room on Earth right now without external –

JM: Yeah. At sea level.

AT: Yeah. It's 1.57 ppm.

JM: Okay.

AT: It's what is allowable. But nano bubbles don't operate under the same physics as larger bubbles do. That's what I was mentioning. They're quasi-dissolved. That's why the water is white, right? If dissolved, the water goes clear. When you can see the bubbles, they're not dissolved. So the water goes white because we're getting seven times more hydrogen than can dissolve in the water. Now, they won't dissipate until they go into the micron range. They're small as like 30 nanometers when you're drinking the water. So actually, this is kind of part of the genius in what invented. It's the smallest bubble, though it alters something called their zeta potential. Rather than wanting to coalesce, they kind of repel each other and resist coalescence.

Now, on top of that, all of these nano bubbles come with hundreds of TSI and internal pressure, right? It acts as a kind of an invisible container around it to further stabilize this. We'd actually measured the dissolved hydrogen under SATP at closer to 3 ppm with no external pressure. Because we're getting that pressure from the nano bubbles. So it should be more and more stable. That's what the next couple thousand in nerve adjustments were listed to spike this nano bubble higher and get it more and more stable by going smaller and smaller in bubble diameter at the right flow rate. When you do them too quickly, they actually coalesce too quickly. Say you put a powder in, not only is it illegal, you drop the powder over magnesium to make hydrogen.

Well, companies selling that are violating ocean regulations, the Department of Transportation (DOT) and the Federal Aviation Administration (FAA). They're shipping a hazardous material and releasing them to consumers. There could be accidents, explosions. But the reaction happens too fast and you don't get the stable gas. We need it to solidify. It's kind of like a time-release, but it's a fast time-release, to make the bubbles at the right flow where it's going.

With that said, ideally you probably want to drink this around room temperature, warm, so it's dissolving closer to a minute and a half. From about a minute, maybe a minute and a half, to six minutes, hitting at equilibrium, it's going to go from 10 down to 1.6, from a minute to six minutes. Between about 45 seconds and a minute and a half, it's stabilized above the 10 ppm. And then it's in a slow slide down. So the faster you drink it the better, but even if you forget and you walk away, you haven't really wasted it because you're still getting 1.6 ppm, which is sometimes 16 times higher than these water ionizers that people buy for 5,000 dollars.

JM: And you're still getting the elemental magnesium, because that doesn't dissipate. It's just the hydrogen that dissipates.

AT: Yeah. Exactly.

JM: Alright. This is just absolutely fantastic. I am just so excited that we had the opportunity to spend some time and learn more about the details and your personal history and how you can serve

or assist a magnificent illustration of someone who even had the magic bullet still needed the benefit from these other powerful strategies of fasting and time-restricted eating, which in my view are probably the two most powerful nutritional interventions aside from stopping drinking soda and juice, fruit juice.

After that, then clearly time-restricted eating. And then paying attention to your chronobiology and your sleep patterns, because it's very clear that you cannot be healthy without sleep. Sleep is almost as important as drinking water and eating. In fact, they deprived mice and rats for eight days and they're dead. That's it. I mean they cannot live eight days without sleep. They're dead.

AT: That's why I monitor how much I sleep. I tend to be able to function on three or four hours of sleep a day. I've gone months on that little sleep in the past.

JM: But you are hurting yourself.

AT: Exactly. Now often I'll wake up after four or five hours and my mind's racing. I work and I start doing things. But I'll listen to guided hypnosis and do breathing.

[-----01:10:00-----]

JM: Do some meditation. Here's another trick that I just learned. I actually learned it from Matthew Walker. Because as you get older, the tendency and the observation is that you're going to decrease your deep sleep. It just seems to happen to almost everyone as they age. But what works magnificently to counteract that is to basically get yourself cold.

I live in Florida so I have a pool full-time. By late October or November, the water starts to get cold, and then it's down to 60 – I mean in the 70 degrees Fahrenheit and now it's in the 60 degrees Fahrenheit. So I do a few laps in the pool right before I'm going to go to bed. I don't dry off. I just let the water evaporate. My core body temperature drops quite dramatically and my deep sleep is literally tripled or quadrupled.

AT: Interesting.

JM: Now, you don't have to swim in the pool. You can just take a shower. Even if it's just a hot shower. Just the water evaporating is going to take the heat away from your core. You'll cool down pretty rapidly. Why don't you play with that and let me know what you already have. I think you're going to see a big improvement in your deep sleep.

AT: No, no. I get it. I get a lot of deep sleep actually.

JM: Well, it's not a big deal for you.

AT: Almost all my sleep is deep and rapid eye movement (REM). I have very little light sleep. All summer, spring and fall, I tend to run an air conditioner to keep my bedroom cold. In the winter, I actually switch it on and I stop being cold at night. I am cold for at least six hours a day in the early morning. I do my body squats. I've got a Muay Thai bag on my patio. I go up barefoot, especially

when it's snowing or frosting. I get cold. I leave my windows open in my home office. I'm just cold for about six hours a day, and then I turn the heat on, right? It's actually important. We've done some really cool research in pigs, which are very close to humans, that show if you're very cold for even eight hours a day, there are benefits in bioenergetics.

JM: Sure. You get brown adipose tissue increases.

AT: Exactly.

JM: Mitochondria biogenesis, PGC1-α. It's crazy.

AT: But if you're a little bit cold all day long, the reverse happens.

JM: Really?

AT: Yeah. Maybe doubly impact bioenergetics. You develop more white adipose tissue. That's been some cool trials in the last couple of years on pigs, showing that a stronger cool – We're not talking about super strong going like -270 degrees Fahrenheit at the cryochambers for three minutes. We're talking four hours to eight hours of being just cold. But if they're cold all day long, they gain weight. Their health –

AT: Yeah. Why would you want to do that? You wouldn't. You wouldn't want to be cold all day. But it's interesting stuff because you don't have to get super cold.

JM: No.

AT: In the wintertime – it's getting to that point now. I have a cold shower in the morning. Once I'm doing my exercises, as I'm doing my exercises throughout the day, I just go up barefoot onto my patio. I just keep the windows open so I'm just uncomfortable for about six hours a day.

JM: Yeah. That's good. I mean playing with temperature is another important variable you can use to improve your health. It sounds like you're doing a pretty good job on it. Alright. So we should probably sign off. I want to thank you for everything you're doing, for your diligence, your perseverance and persistence in bringing together a product that really works and that just kicks butt in helping improve people's health and helping take control of their health in such an unbelievable innovation to really help us regain our ability to be optimally healthy. Thank you for all that.

AT: No problem. Thank you very much for having me.

[END]