

# The Science Behind Molecular Hydrogen Tablets

Analysis by [Dr. Joseph Mercola](#)

December 08, 2024

## STORY AT-A-GLANCE

- › Molecular hydrogen (H<sub>2</sub>) 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

***Editor's Note: This article is a reprint. It was originally published December 15, 2019.***

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

## What Is Molecular Hydrogen?

Molecular hydrogen (H<sub>2</sub>) – 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.

H<sub>2</sub> 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<sup>1</sup> 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 ..."*

*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 ...*

*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 ...*

*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.*

*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 H<sub>2</sub> 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.<sup>2,3</sup> Animal research<sup>4</sup> 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

---

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