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A Godsend Against 170 Diseases, It Also Snuffs Out Diseases

Analysis by Dr. Joseph Mercola Fact Checked | April 10, 2022

STORY AT-A-GLANCE

- Molecular hydrogen (H2) is a gas with 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
- There are more than 1,000 publications on molecular hydrogen, which demonstrate therapeutic potential in over 170 different human and animal disease models
- Hydrogen is shown to benefit every organ of the human body, effectively mitigating oxidative stress and inflammation
- There are several ways to administer hydrogen, including hydrogen gas inhalation, drinking and/or bathing in hydrogen-rich water, intravenous hydrogen-rich saline injection and hyperbaric hydrogen therapy

This article was previously published October 21, 2018, and has been updated with new information.

Molecular hydrogen is a gas with unique and selective antioxidant effects.[1] Tyler W. LeBaron is a world-class expert on molecular hydrogen, who has done research at Nagoya University in Japan, where most of his research started. He's executive director of the Molecular Hydrogen Institute (MHI), which is a science-based nonprofit under

Section 501(c)(3). MHI is focused on advancing the research, education and awareness of hydrogen as a therapeutic medical gas.

He's also director of several other nonprofit organizations, including the International Hydrogen Standards Association, which is currently creating standards for the ISO criteria for measurement of hydrogen gas. The reason you probably haven't heard of molecular hydrogen is because it's relatively new. The landmark paper published on it in Nature Medicine came out only 10 years ago (2007), and most of the research has been done in Asia.

Molecular Hydrogen 101

Molecular hydrogen refers to diatomic hydrogen or H2 gas — two hydrogen atoms combined together. Hydrogen is the smallest molecule in the universe, and is neutral and nonpolar, which is why its bioavailability is so great. It does not dissociate into its electrons and protons when dissolved in water, so it will not alter the pH of water or your body and has nothing to do with the alkaline water concept.

> *"It's just hydrogen gas. It's three times more energy-dense than gasoline. That's why it's being looked at as an alternative energy source or fuel,"* LeBaron says. *"It's what powers the sun and fusion in producing helium. This is the hydrogen we're talking about and we're seeing it can also be therapeutic, [and is] effective whether you inhale it, dissolve it in water and drink it, or other methods of application.*
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> *In 2009, I came across an article published in Nature Medicine[2] [in 2007] … [which] showed [2 percent] hydrogen [gas] was effective at preventing the brain damage from ischemia reperfusion induced by a middle cerebral artery occlusion in a rat model … I was getting my degree in biochemistry at the time, but I've always been interested in health …*
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> *I took it from there and was able to read all the research, all the literature, and continue advancing in this area, then later go to Japan. Now I'm able to work*

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

Molecular Hydrogen Has Unique, Selective Antioxidant Effects

Molecular hydrogen remediates oxidative stress, which is one of the most fundamental mechanisms that destroys human health. That's why molecular hydrogen is so exciting —it has such unique antioxidant effects that specifically target only the most harmful free radicals. Now, while you might think the hydrogen gas dissociates or neutralizes hydroxyl free radicals (which cause the most oxidative damage), it doesn't appear to work that way.

There are more than 1,000 peer-reviewed scientific publications on molecular hydrogen, which 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, The reason why is because hydrogen targets and mitigates the root cause of many diseases, inflammation and oxidation. But just how does it do this? LeBaron explains:

"To understand how hydrogen works, we need to understand how free radicals work and why they're produced. First, the hydroxyl radical, which is OH neutral with a lone pair electron, is produced in your body through the Fenton reaction. When free radicals get too high, like superoxide radicals, peroxynitrite [or] ionizing radiation,[3] [they] can be converted to hydroxyl radicals … [Hydroxyl radicals] are damaging because they're so reactive …

When you look at other free radicals [such as] nitric oxide, that's a very important free radical which causes vasodilation. We don't want to neutralize that. We have superoxide radicals [and] other oxidants like hydrogen peroxide — these are all very important.

Of course, too much is bad, but having them in the right concentrations and at the right locations is very good for you. We don't want to just neutralize all of

those, whereas hydroxyl radicals or peroxynitrite oxidants, we don't want any of them.

That Nature Medicine publication specifically showed that hydrogen could act as a therapeutic antioxidant by selectively reducing the cytotoxic oxygen radicals, specifically the hydroxyl radical and to a lesser extent peroxynitrite, without decreasing the other oxidants like hydrogen peroxide or superoxide …

Most other antioxidants are not selective … [and] that can be problematic … Hydrogen is selective in that it's only going to decrease or reduce those toxic radicals like the hydroxyl radical.[4]*"*

How Molecular Hydrogen Works

There are two basic definitions of an antioxidant: 1) a molecule that donates an electron to a radical reaction, and 2) a molecule that improves the redox status of the cell. Redox stands for oxidation reduction. In your cells, you need both oxidation and a reduction of oxidation in order for everything to work properly.

When that balance gets perturbed by too much oxidation, you end up with oxidative stress. If you don't have enough oxidation, you end up with other serious problems. In many cases, damage is not caused by an excess of free radicals but rather a redox dysregulation.

"We need free radicals," LeBaron says, *"and studies have shown you can actually suffer from too much oxidative stress and too much reductive stress*[5] *(or not enough oxidative potential) not only in the same body or the same organ, but in the exact same cell. Too much oxidative stress in the cytosol; not enough oxidative power in endoplasmic reticulum. Hydrogen helps to bring everything back to homeostasis."*

So, while hydrogen has antioxidant effects, it works primarily by improving the redox status of the cell when needed. As a result, you see improvements in superoxide dismutase 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.

Another way is by activating the Nrf2 pathway when the activation is 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.

> *"One study[6,7] [looking at] metabolic syndrome found that subjects drinking hydrogen-enriched water had a 39 percent increase in extracellular superoxide dismutase. So, yes, hydrogen does have this antioxidant-like effect, because it can help regulate Nrf2 pathway[8] and bring enzymes and cytoprotective proteins back to the levels they're supposed to be; back into that realm of homeostasis."*

Cyclical Ingestion Is Key for Optimal Effectiveness

Depending on the individual and their diet, intestinal bacteria that ferment fiber produce about 2.5 gallons of hydrogen gas per day,[9] which is part of the therapeutic benefits of fiber. From an evolutionary perspective, we've also always been exposed to hydrogen gas.[10,11]

These facts alone are indicative of its safety. "Anybody can have it — pregnant women, children, everybody. Hydrogen gas itself is very safe. They have used it in deep sea diving to prevent decompression sickness[12] since the 1940s," LeBaron says. (Normally, helium gas is used but for very deep dives, hydrogen gas is used, such as hydrox, which is 96 percent hydrogen.)

Now, if hydrogen gas is so beneficial, and your body already produces loads of it, why would ingesting hydrogen-rich water still be therapeutic, seeing how you're getting far lower amounts of hydrogen this way?

Interestingly, one Nagoya University study[13] showed that while continuous administration of hydrogen in air was ineffective for the prevention of Parkinson's disease, intermittent exposure was effective. The greatest effects, however, were obtained by drinking hydrogen-rich water. Just what is it about cyclical or intermittent exposure (opposed to continuous) that makes such a big difference? LeBaron explains:

> *"It appears to be more of a gaseous-signal modulator. The way a signal modulator works is, it needs to have this intermittent type exposure, or else you get habituation or subsequent attenuation of the signal. That's what we're seeing with hydrogen gas … it modulates gene expression, protein phosphorylation and many transcription factors, but the primary targets remain elusive.*

Molecular hydrogen has also shown clinically to have some great benefits. More research is always needed, but there are some compelling ones that show its safety and effectiveness.

> *[In one study[14]] they had 50 patients with cerebral infarction; 25 [received] hydrogen inhalation and 25 in the control group [received] an approved medical drug … [T]he hydrogen was significantly more effective than the approved drug on all the measured parameters, with no side effects.*
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> *Again, the reason I'm so passionate about hydrogen is because here we have a molecule that is simple, safe, easy to administer, and actually has some really significant therapeutic potential.*
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> *There was just another study published for … Alzheimer's disease. If you look at the genotype, those with the APOE4 genotype is susceptible to Alzheimer's disease … When we look at the effects of drinking hydrogen-rich water … they found it was significantly therapeutic for this disease. That's big because there are no approved drugs that are effective for Alzheimer's disease."*

Molecular Hydrogen Mimics Effects of Fasting

Interestingly, there's evidence to suggest that if you have the APOE4 gene, you really need to intermittently fast to avoid Alzheimer's, and one of the pathways that hydrogen seems to mimic is that of fasting. Dr. Dale Bredesen expands on this in his book "The End of Alzheimer's."

LeBaron cites a study published in the Journal of Obesity, which basically shows that drinking hydrogen-rich water had the same effect as restricting calories by about 20%. Also, both fasting and molecular hydrogen increase neuroprotective gastric ghrelin secretion, a hunger hormone, and in at least one study, this was shown to be one of the primary mediators in benefiting those with Parkinson's disease.[15,16,17]

Hydrogen Applications for Diabetes

Clinical studies have also shown molecular hydrogen effectively prevents liver damage (fatty liver) caused by a high-sugar diet and metabolic syndrome.[18,19] "In some of the metabolic syndrome studies, glucose levels in some of those with impaired glucose tolerance were brought back to the normal range," LeBaron says. Animal research[20] suggest hydrogen may induce GLUT4 translocation by a similar mechanism as insulin.

"We need more studies to investigate this, but some of this preliminary data is really showing it's a great for these diabetics,[21]" he says. There's also some evidence[22,23,24,25] it may help suppress cancer growth as an adjunctive treatment and ameliorate the toxicity of cancer drugs,[26] but LeBaron is cautious in this regard, saying more research is needed.

Available Hydrogen Therapies

There are a number of ways to administer hydrogen. For example, you can inhale hydrogen gas, and for this, there are inhalation machines you can buy. Caution is required, however. The gas produced at the cathode is hydrogen gas, but if the electrodes are impure or develop mineral buildup, and the water you're using has chloride in it, then chlorine gas can be produced, which you would then inhale.

Other methods are drinking and/or bathing in hydrogen-rich water, and there are several ways to do that. For example, you could bubble it into the water from a tank of hydrogen gas and dissolve it under pressure. Just keep in mind that if you plan on storing it, you cannot use plastic containers, as the hydrogen molecules are so small they'll dissipate right through the container.

For clarification, hydrogen gas is simply two hydrogen atoms bound together. When you dissolve it into water, it will not attach to the water molecules, so there's no risk that you're going to create some other structure. There are also intravenous hydrogen-rich saline injections and hyperbaric hydrogen therapy, developed in Japan.

How to Measure the Concentration of Hydrogen Gas

One way to check the quality of your molecular hydrogen product is to use a redox titration reagent called H2 Blue. This is available on many different websites, including Amazon.

This allows you to measure the concentration of hydrogen in the water you're about to drink. To do this, simply fill the small beaker with 6 milliliters of your hydrogen water. If there's no hydrogen gas in there, the blue reagent will remain blue

If hydrogen gas is present, the reagent will turn from blue to clear. Once it turns clear, add another drop of the reagent. Keep adding a drop at a time until the solution turns blue and stays blue. This is called the titration endpoint.

Simply count how many drops it took to get there. Each drop is equivalent to about 0.1 milligram per liter and the number of drops required to neutralize the test solution will determine the concentration of molecular hydrogen. So, if you had to add 10 drops, you would have 1 milligram of hydrogen per liter.

Therapeutic Dosages

Unfortunately, there's still insufficient data on what the minimum effective concentration is. There are many variables involved. However, as a very general guideline, clinical studies have shown therapeutic effects at doses ranging from 0.5 milligrams to 5 milligrams or more of hydrogen per day. We should be able to obtain this dose by consuming no more than 1 liter of hydrogen-enriched water according to IHSA standards.

"We need more research, but it appears, at least in some of these studies, that a higher concentration or a higher dose is as effective as and sometimes more effective than a lower amount," LeBaron says.

In terms of half-life, if you were to drink hydrogen-rich water, you're going to reach a peak blood level and breath exhalation point after about five to 15 minutes depending on the dose. This demonstrates that hydrogen can easily diffuse into the bloodstream in order to measure changes in the breath. Your hydrogen level returns to baseline in about an hour or so.

> *"That's also how we know hydrogen is more of a signal modulator, because you can drink the hydrogen water and it's gone out of the system within an hour, yet it has residual, therapeutic, protective effects that last for hours, days and even weeks.*
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> *One small, double-blinded, randomized study[27] on rheumatoid arthritis found that drinking hydrogen-rich water was very effective for the disease … Those with early onset rheumatoid arthritis had remission. During the washout period, no one was taking hydrogen and they … continued to see improvements in the disease for an additional four weeks …*
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> *[The reason for this is] because you're targeting gene expression.[28] By taking hydrogen, within three days we see increases for PGC-1α, [which] is mitochondrial biogenesis … There are so many different transcription factors hydrogen operates on, so if we start to alter the gene expression, then some of these changes of the signal modulator can last for quite some time, so we get residual effects."*

More Information

To learn more about molecular hydrogen, please visit 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.

> *"Again, we are a science-based nonprofit working to advance the research, education and awareness of hydrogen as a medical gas, so you're not going to find products and things on our site, but you will find a lot of information, and we do our best to provide what's going on in the hydrogen area,"* LeBaron says.
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> *"I hope that you'll review this video, review the information on hydrogen, and although we have a responsibility as researchers to understand the molecular mechanisms and targets of hydrogen and do clinical studies, because we have a molecule so significant, and so safe, perhaps it's also your responsibility to share it; to let other people know about it.*
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> *There's so many people who don't have access to medical care that this could really benefit. There are also those who have access to too much medical care, where hydrogen can help mitigate the toxic effects."*

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