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Molecular Hydrogen: The Powerful Antioxidant You've Never Heard Of

Analysis by Dr. Joseph Mercola | October 20, 2024

STORY AT-A-GLANCE

- I recently interviewed Tyler W. LeBaron, Ph.D. about molecular hydrogen, a unique antioxidant that can address both oxidative and reductive stress, acting as a redox adaptogen to restore cellular balance without disrupting natural signaling processes
- Hydrogen's unique properties allow it to selectively target harmful free radicals, reduce inflammation, activate antioxidant pathways and mitigate damage from environmental toxins with no known side effects
- Practical ways to consume molecular hydrogen include hydrogen-rich water (often via tablets) and promoting gut health to increase natural hydrogen production
- Pulsed dosing of hydrogen therapy is more effective than continuous administration. Consuming hydrogen-rich water immediately after preparation ensures maximum benefit due to quick dissipation

In my ongoing quest to deliver the most effective strategies for optimizing your health, I recently had the pleasure of speaking with Tyler W. LeBaron, Ph.D., one of the world's foremost experts on molecular hydrogen.

LeBaron, founder of the Molecular Hydrogen Institute, is an accomplished marathon runner and strength athlete who pushes his body to extremes that most of us can't imagine. He's deadlifted 450 pounds and has run marathons in the low 2:20 range — a pace that used to win the Boston Marathon not many years ago.

Our conversation covered everything from the intricacies of mitochondrial function to the potential of hydrogen as a selective yet safe antioxidant — as well as targeting the problem of plastic pollution that's exposing the population to toxic endocrine-disrupting chemicals (EDCs).

LeBaron delves into the emerging science behind molecular hydrogen as a powerful therapeutic agent, providing invaluable insights into how this simple molecule could be the key to addressing one of the most overlooked issues in cellular health: reductive stress.

The Mitochondrial Energy Crisis

At the heart of our discussion was the intricate process of cellular energy production within your mitochondria. LeBaron broke down the complexities of the electron transport chain, explaining how your cells generate ATP, the energy currency of life. The process begins when you consume food:

1. Food is broken down into glucose, which enters your cells. Through glycolysis in the cytoplasm, glucose is partially oxidized, producing a small amount of ATP and NADH.
2. The resulting pyruvate enters your mitochondria, where it's further oxidized in the Krebs cycle.
3. Electrons from this process are transferred to the electron transport chain in your inner mitochondrial membrane.
4. As electrons flow through the chain, protons are pumped into the intermembrane space, creating a gradient.
5. This gradient drives ATP production as protons flow back through ATP synthase.

Throughout this process, a small percentage of oxygen is converted to free radicals. While some free radical production is normal and even beneficial for cellular signaling, an excess typically leads to damaging oxidative stress.

While incredibly efficient, the process is not without its challenges. When the system becomes imbalanced, it can lead to a state of oxidative stress — a concept many are familiar with. However, what's less understood is the equally problematic condition of reductive stress.

Reductive Stress: The Hidden Threat to Cellular Health

Reductive stress occurs when there's an excess of electrons in your mitochondrial electron transport chain (ETC). This surplus disrupts the delicate balance in your ETC, leading to decreased energy production and increased free radical formation.

"When these electrons start backing up," LeBaron says, "you can cause what's called reverse electron transport. Instead of normally where you would be oxidizing NADH to form NAD+, you would actually start reducing NAD+ to form NADH."[1]

This reversal can significantly impair metabolism and cellular function. It's a problem that's often overlooked but is at the root of many chronic health issues. Your body needs a delicate balance, what LeBaron calls "redox homeostasis." Too much oxidation leads to damage, while too much reduction impairs energy production.

While many turn to antioxidant supplements to combat oxidative stress, LeBaron cautioned against their overuse:[2]

> *"Taking conventional antioxidants at high doses can actually negate the benefits of exercise training. When you start negating those free radicals and neutralizing them prematurely, you can potentially be blunting a lot of the main benefits of your mitochondria."*[3]

This insight underscores the need for a more nuanced approach to cellular health — one that addresses both oxidative and reductive stress without disrupting the body's natural signaling processes. This is where molecular hydrogen enters the picture.

Molecular Hydrogen: Nature's Adaptogen

What makes molecular hydrogen so unique is its ability to act as a redox adaptogen, helping to restore balance whether you're dealing with oxidative or reductive stress. This simple molecule, consisting of just two hydrogen atoms, has been the focus of LeBaron's research for years.

And for good reason — it's uniquely suited to address the challenges of both oxidative and reductive stress.[4] He shared some fascinating research showing how hydrogen gas can:

1. Suppress excess superoxide production in cases of oxidative stress
2. Promote forward electron transport when there's reductive stress
3. Induce mild, beneficial hormetic stress that activates our cellular defense systems

Unlike conventional antioxidants that can sometimes blunt beneficial adaptations to exercise, hydrogen enhances these positive changes while still offering protection. "Molecular hydrogen really is an interesting solution," LeBaron said. "It's not a strong drug but it acts as this rectifier, as a modulator, as this adaptogenic molecule, so that it helps to keep things in check."[5,6]

What makes hydrogen so special is its ability to selectively target harmful free radicals while leaving beneficial ones intact. This selectivity is crucial, as some level of oxidative stress is necessary for proper cellular function and signaling.

As the smallest molecule in the universe, hydrogen can easily penetrate cell membranes and even enter your mitochondria. This allows it to exert effects precisely where they're needed most. Some of the potential benefits LeBaron highlighted include:[7]

- Reducing inflammation
- Activating antioxidant pathways like Nrf2
- Promoting mitochondrial biogenesis
- Enhancing autophagy
- Mitigating damage from environmental toxins

Importantly, hydrogen appears to have no known side effects when used properly. This safety profile, combined with its wide-ranging benefits, makes it an intriguing option for nearly everyone looking to optimize their health.

Practical Ways to Harness the Power of Hydrogen

While molecular hydrogen shows immense promise, getting therapeutic doses isn't always straightforward. LeBaron outlined a few methods for administering hydrogen:

1. **Hydrogen water —** Dissolving hydrogen gas in water is the most common approach used in research. Tablets that generate hydrogen when added to water offer a convenient option.
2. **Inhalation —** Some devices allow for direct inhalation of hydrogen gas, though safety precautions are crucial as high concentrations can be explosive.
3. **Naturally produced hydrogen —** A healthy gut microbiome can produce hydrogen gas when given the right nutrients, highlighting another reason to prioritize gut health.

The key with any method is achieving a high enough concentration and consuming it quickly, as hydrogen easily dissipates. When using tablets, it's best to drink the water while it's still cloudy, within about 90 seconds of adding the tablet. This immediacy of consumption ensures you're getting the maximum benefit from the hydrogen-rich water.

"Most research and most studies are still done with just drinking hydrogen water," LeBaron noted. "The tablet is a convenient way for a lot of people just because you drop the tablet in there and it does produce a high dose of hydrogen that's going to provide you with clinically relevant doses similar to what we use in the clinical studies."[8]

While its antioxidant properties are impressive, the benefits of molecular hydrogen extend far beyond simply neutralizing free radicals.[9] LeBaron explained how hydrogen can act as a cellular modulator, influencing various pathways and processes, including aging and toxic effects from environmental pollutants:[10,11]

"We're all getting older. And as you get older, you have more senescence. You have these pathological cells that just produce a little more free radicals than they normally would otherwise and more inflammation than they would otherwise. Taking hydrogen gas helps to reduce and modulate that and helps to activate things like autophagy, as well as helps to prevent excessive autophagy.

So, it modulates this entire process that happens as we age. So, I think we're all susceptible to aging, unfortunately, and hydrogen is going to help with that. And then the other issue living in this world is we are always exposed to some sorts of toxins, whether it's the plastics that we get our foods in, we go outside and it's just smoky. We have wildfires around here. We have pollution from the cars.

… And we have seen a lot of studies showing that when we administer hydrogen gas simultaneously or before the administration of some of these environmental pollutants and toxins, hydrogen gas prevents or helps to mitigate against some of these toxic effects."

LeBaron takes hydrogen almost daily, not just for its potential performance benefits, but also to help counteract the oxidative stress and inflammation that can result from high-intensity training.[12] This approach aligns with the adaptogenic properties of hydrogen we discussed earlier, as it helps your body maintain balance even under significant physical strain.

The Arm-Wrestling Phenomenon

One interesting point about LeBaron is his prowess as an arm wrestler. Despite often competing against much larger opponents, he has achieved remarkable success in this sport and actually taught me how to arm wrestle as well. LeBaron's explanation of the technique involved is enlightening for anyone interested in physical fitness:

1. Proper form and leverage are crucial, often more important than raw strength.
2. Specific training of the forearm and finger muscles is key, areas often neglected in traditional strength training.

3. Mental focus and quick reaction times can often overcome size disadvantages.

At 69, I found myself **arm wrestling with Dr. Marcos de Andrade**, a 38-year-old extreme fitness enthusiast, at a Biohacking Conference — and winning. However, LeBaron also taught de Andrade the same arm-wrestling techniques he shared with me.

LeBaron's, as well as my own, success in arm wrestling serves as a powerful demonstration of how optimized mitochondrial function and energy production can translate into real-world physical performance. It's a reminder that true fitness isn't just about how much weight you can lift or how far you can run, but also about how efficiently your body can generate and utilize energy at the cellular level.

The Dangers of Plastic Pollution

While our conversation primarily focused on hydrogen, we also touched on the growing threat of plastic pollution. Plastic production has skyrocketed from just 1 million pounds per year in 1950 to a staggering 400 million tons in 2023. Even more alarmingly, projections suggest this could reach 1.2 billion tons annually by 2060.[13]

This isn't just an environmental issue — it's a major health concern. Microplastics are now ubiquitous, with the average person consuming about a credit card's worth of plastic each week.[14] These plastics, along with other EDCs, disrupt your hormones and mitochondrial function in ways similar to the damage caused by excess **linoleic acid from seed oils**.

I'm excited to be working with LeBaron to explore potential solutions to this critical problem. While we don't have all the answers yet, raising awareness and supporting research in this area is crucial for the health of both humanity and our planet.

The Importance of Pulsed Dosing for Hydrogen Therapy

One crucial point that emerged from our discussion was the importance of pulsed dosing when it comes to hydrogen therapy. While it might seem intuitive that more is

always better, LeBaron explained that continuous exposure to hydrogen gas may reduce its effectiveness.

As such, pulsed exposure to hydrogen is likely more effective than constant administration. This insight has important implications for how to approach hydrogen therapy:

- Drinking hydrogen-rich water at specific times during the day is more effective than sipping it constantly.
- Short sessions (1 to 3 h) of hydrogen inhalation may be preferable to longer (20+ h), continuous exposure.
- Allowing at least some hours without hydrogen supplementation could possibly enhance your body's response when it’s reintroduced.

A practical challenge in hydrogen therapy is accurately measuring the concentration of hydrogen in water or gas. LeBaron pointed out that many commercially available devices aren't sensitive or accurate enough for this purpose. In his research, he uses gas chromatography to precisely measure hydrogen levels.

For those using hydrogen at home, this means you need to be cautious about claims made by various products. The most reliable approach is to use methods that have been validated in clinical studies, such as certain hydrogen-generating tablets that have been shown to produce therapeutic levels of hydrogen.

Practical Implications for Incorporating Hydrogen Into Your Health Regimen

Given the safety profile and benefits of molecular hydrogen, it's worth considering as part of a comprehensive health strategy. Here are some key takeaways:

1. **Consider daily supplementation —** While not everyone may need it, the potential benefits and lack of side effects make hydrogen a low-risk, high-reward option.

2. **Choose the right delivery method —** Hydrogen-rich water, particularly from tablets, offers a convenient and effective way to supplement.
3. **Timing matters —** Consume hydrogen-rich water immediately after preparation to ensure maximum benefit.
4. **Embrace other healthy habits —** Hydrogen therapy is most effective when combined with a healthy diet, regular daily movement and other positive lifestyle factors.
5. **Stay informed —** As research in this field continues to evolve, staying up-to-date with the latest findings can help you optimize your use of hydrogen therapy.

Hydrogen Is Useful, but Don’t Solely Rely on It

While molecular hydrogen is not a magic bullet, its ability to help restore cellular balance with virtually no downside makes it a compelling option for most people. I'm particularly intrigued by its potential to address reductive stress, a concept that's often overlooked in discussions of cellular health. As someone who has long been interested in mitochondrial function and energy production, I see hydrogen as a valuable tool in your health optimization toolkit.

That said, it's important to remember that hydrogen supplementation isn't a replacement for a healthy lifestyle. Proper nutrition, regular exercise, quality sleep and stress management remain the foundations of good health. Hydrogen can be seen as an additional support to these core practices.

Moving forward, I plan to incorporate more information about molecular hydrogen into my work, including in the upcoming professional reference guide version of my book, "Your Guide to Cellular Health." I'm grateful to LeBaron for sharing his expertise and helping to refine my understanding of this fascinating area of research.

Sources and References

- [1, 2, 5, 8, 10] Youtube, Dr. Mercola, Molecular Hydrogen: The Powerful Antioxidant You've Never Heard Of — Interview With Tyler LeBaron
- [3] Journal of Sport and Health Science, Volume 13, Issue 6, November 2024, Pages 780-792
- [4] Biochemical and Biophysical Research Communications, Volume 522, Issue 4, 19 February 2020, Pages 965-970
- [6, 12] Can J Physiol Pharmacol. 2019 Sep;97(9):797-807. doi: 10.1139/cjpp-2019-0067. Epub 2019 Apr 10
- [7] Antioxidants (Basel). 2020 Dec 15;9(12):1281. doi: 10.3390/antiox9121281
- [9] Current Pharmaceutical Design, Volume 27, Number 5, 2021, pp. 610-625(16)
- [11] Circ J. 2016 Aug 25;80(9):2037-46. doi: 10.1253/circj.CJ-16-0227. Epub 2016 Jul 29
- [13] Organisation for Economic Co-operation and Development (OECD) June 3, 2022
- [14] WWF Analysis, No Plastic in Nature: Assessing Plastic Ingestion From Nature To People June 2019