

## OVERVIEW OF THE ADVANTAGES OF MOLECULAR HYDROGEN FOR MEDICAL APPLICATIONS

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It has been clearly demonstrated that molecular hydrogen (H<sub>2</sub>) has different and many advantages exhibiting marked effects for various medical applications: it is mild enough neither to disturb metabolic redox reactions nor to affect signalling by reactive oxygen species (ROS). It should have, up to now, no or little adverse effects. H<sub>2</sub> can be monitored with an H<sub>2</sub>-specific electrode or by gas chromatography. H<sub>2</sub> rapidly diffuse into tissues and cells to exhibit efficient effects.

Thus, it could be used for preventive and therapeutic applications by different methods: inhaling H<sub>2</sub> gas, drinking H<sub>2</sub>-dissolved water, injecting H<sub>2</sub>-dissolved saline, taking an H<sub>2</sub> bath or dropping H<sub>2</sub>-saline onto the eyes. Recent publications revealed that, in addition to the direct neutralization of highly reactive oxidants, H<sub>2</sub> indirectly reduces oxidative stress by regulating the expression of various genes. H<sub>2</sub> appears to also reduce a powerful oxidant, peroxynitrite (ONOO<sup>-</sup>). This would mean that H<sub>2</sub> has the potential to protect our DNA/RNA and proteins from damage linked to oxidative stress. It seems that it does this while not perturbing cellular homeostasis. H<sub>2</sub> appears to stimulate the production of endogenous antioxidants via the Nrf2 pathway, meaning it up-regulates the body's own antioxidant system. This results in the production of more protective enzymes such as glutathione, catalase, and superoxide dismutase. These antioxidants are powerful and aid in the reduction of excessive ROS and oxidative-stress within the body, which have been linked to nearly all human diseases. Moreover H<sub>2</sub> can regulate inflammatory cytokines, hormones and proteins.

Research shows, that H<sub>2</sub> has the potential to exhibits these effects:

anti-inflammatory effects, selective antioxidant, anti-allergic effects, anti-cellular death, anti-aging, reduces aches and pains, protective to skin, cardioprotective, decreases muscle fatigue, reduces lactate levels, may contribute to induce anti-diabetic effects, improves cognitive function and cytotoxic protection and can have a neuroprotective effect, a radiation protection effect and can be considered as cytoprotective agent.

In addition to growing evidence obtained by model animal experiments, extensive clinical examinations were performed or are under way, particularly to improve the knowledge of cellular action and the impact of effect of hydrogen water over usual concentration of dissolved hydrogen.

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