ENABLING

MICROSCALE

RESEARCH

Biomedical implications of H_2 enriched drinking water

Unisense hydrogen sensors used for detection of H_2 in biomedical research and in production control of H_2 enriched water

H_2 sensor characteristics:

- Sensor for dissolved and gaseous hydrogen
- Detection range from below 50 nM to saturated H_2 water
- Real-time data
- Response time in seconds
- Modifications and customizations available
- Easy calibration and linear response

Drinking water enriched with dissolved hydrogen has been reported to have a positive effect on many healths and well being conditions. This has made a market, predominately in Japan, to commercialize H_2-enriched water for health and body recovery processes.

Unisense hydrogen microsensors have been used to document the possible positive effect of H_2-enriched drinking water as a biomedical treatment. In the study by Kamimura et al. (2011) they found that obese rats that received H_2 water were less affected by oxidative stress in connection with obesity compared to rats that received normal water.

Using a needle type H_2 microsensor, the H_2 concentration was monitored in rat liver. The measurements showed that H_2 was accumulated in liver of fed rats but not in fasted rats (Kamimura personal communication).

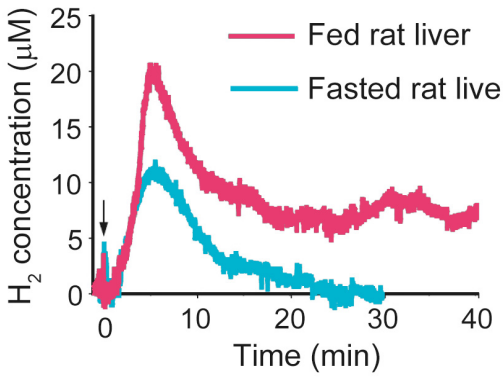

Figure 1. Hydrogen concentration measured in rat liver of a fed or overnight-fasted rat liver. Arrow indicates when the rats received H_2 enriched drinking water.

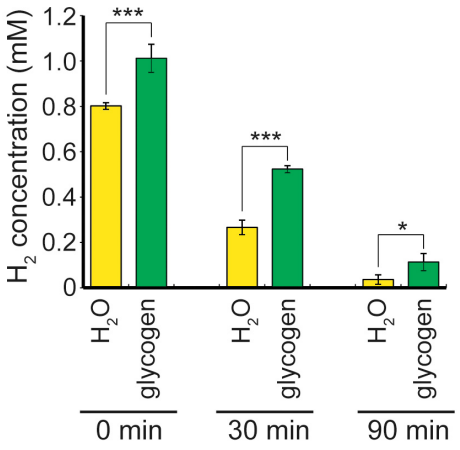

*Figure 2. Hydrogen concentration in open tubes with water and glycogen respectively after bubbling with H_2. Data are based on three replicates, * P<0.05, *** P<0.001.*

The study also showed that a fatty liver from the rats drinking H_2 rich water contained less oxidative stress marker proteins and looked healthier compared to the fat rats, that did not receive H_2 enriched water. Hydrogen's anti-oxidative effect on the liver is speculated to explain the difference.

Unisense H_2 microsensors are used by manufacturers of commercial hydrogen enriched water to control and monitor the dissolved H_2 concentration.

Examples of commercially available hydrogen enriched drinking water

Sensors

Various customizations of the H_2 sensors

Amplifier

Microsensor Multimeter

Selected references in which Unisense hydrogen sensors have been used to show the effect of hydrogen in biomedical applications:

Kamimura et al. (2011), Molecular Hydrogen Improves Obesity and Diabetes by Inducing Hepatic FG21 and Stimulating Energy Metabolism in db/db Mice, Obesity, Vol. 19: 1396-1403.

Terasaki et al. (2012) Hydrogen therapy attenuates irradiation-induced lung damage by reducing oxidative stress. Am J Physiol Lung Cell Mol Physiol, Vol. 301: L415-L426.

Sun et al. (2011) The protective role of hydrogen-rich saline in experimental liver injury in mice. Journal of Hepatology, Vol. 54: 471-480.

Yamamoto et al. (2019) Hydrogen gas distribution in organs after inhalation: Real-time monitoring of tissue hydrogen concentration in rat. Scientific Reports, Vol 9, Issue 1. 1255.

Terasaki et al. (2019) Molecular hydrogen attenuates gefitinib-induced exacerbation of naphtalene-evoked acute lung injury through a reduction in oxidative stress and inflammation, Laboratory Investigation.

Iketani et al. (2018) Administration of hydrogen-rich water prevents vascular aging of the aorta in LDL receptor-deficient mice, Scientific Reports, Vol 8, Issue 1, p. 1-11.

He et al. (2017) Image-Guided Hydrogen Gas Delivery for Protection from Myocardial Ischemia-Reperfusion Injury via Microbubbles, ACS Applied Materials and Interfaces, Vol 9, Issue 25, p. 21190-21199.