

Preface

Oxygen sustains the lives of thousands of aerobionts as an irreplaceable element. Oxygen is necessary and beneficial. It is the particularly final electron acceptor in human body. In cells, the components of the entire human entity, oxygen assists the continual process of metabolism of substances and energy. In other words, energy that sustains all the life activity of the body comes from nutritive substances that cannot be in occupation without the existence of oxygen. However, oxygen is unnecessary and harmful when it is excessive or over tension. People who breathe oxygen that is over 50% of the volume fraction of air for a considerable period may have problems. The excess of oxygen may convey toxicity, even causing pulmonary injury which is also defined as pulmonary oxygen intoxication, demonstrating intoxication caused by oxygen overdose inhalation. In addition, breathing hyperbaric oxygen that exceeds 304 kPa (3 atm) could introduce encephalon oxygen poisoning. For now, it is believed that oxygen toxicity is caused by excess oxygen introducing reactive oxygen species (ROS) in the organism.

ROS has a long history of accusations of culpability in different kinds of diseases, and it is convincible that eliminating ROS will cure the disease. However, this viewpoint is not partial but unacceptable. Although ROS over a certain degree causes body damage, ROS of normal concentration is an irreplaceable condition for maintaining health. Why is ROS important for the health of the body?

ROS is derived of free radical oxygen or non-free radical oxygen with intensely oxidative or reductive functions. We can also put it this way, that ROS is an oxygen element-containing group with powerful reactive activity in aerobic organisms, such as human beings. The most common ROS in the body is superoxide anion, hydrogen peroxide, and nitric oxide. Nitric oxide is one of the crucial signal molecules with an extensive biological effect. Vascular endothelial cells rely on nitric oxide to modulate normal blood pressure. In general, nitric oxide is one kind of significant free radical and is also a major kind of ROS.

Therefore, it is a common misunderstanding that ROS are destructive to the human body and it is better to remove them to protect the body. Considering all ROS as a package and dealing with all of them is the wrong idea. There are a variety of ROS in organism. One group, such as superoxide anion, hydrogen peroxide, nitric oxide etc., has relatively low activity and is favorable to the human body. Only a

situation where these ROS are produced excessively could cause damage to body. Another group, such as hydroxyl free radical, nitrous acid anions, and hypochlorous acid radical, is highly reactive, although these free radicals are rare, reacting easily with intracellular protein, nucleic acid, and lipids by irreversible chemical reaction. These reactions cause fatal damage to the molecule. This damage is called oxidative damage. This kind of injury is the most common and basic pathophysiology mechanism for generation and development of human disease. There is a certain amount of clinical and basically medical research that has verified that common diseases, such as cardiovascular disease, cerebrovascular disease, inflammation, malignant carcinoma, diabetes and arteriosclerosis are caused by ROS introduced oxidative damage. Essentially, it is the ROS group with a minor amount but intoxicate capacity that develops oxidative damage. In general, there are two kinds of ROS. One is the ROS group characterized as large in number, low in activity and beneficial; the other ROS group is small in number, high in activity, and destructive to the body. According to this, there are flaws in treating ROS-caused disease by administrating strong reductive drugs (as vitamins) to eliminate all ROS. A strong reductant treats ROS as a whole and cannot selectively remove those that are high in reactivity and harmful. Only substance with a selectively antioxidant effect (which selectively neutralizes harmful ROS) is the perfect antioxidative drug. It has been demonstrated by a lot of research, that hydrogen could selectively neutralize hydroxyl free radicals and nitrous acid anions. This is the fundamental theory for hydrogen treating disease via its antioxidative effect.

According to the research, hydrogen shows a protective effect in multiple diseases. For instance, malignant carcinoma, colitis, encephalopathia after carbon monoxide poisoning, cerebral ischemia, senile dementia, Parkinson's disease, depression, spinal injury, skin allergy, diabetes type 2, acute pancreatitis, organ transplantation, intestinal ischemia, systematic inflammation reaction, radioactive injury, retina injury, deafness, etc. However, till now, only type 2 diabetes, cerebral ischemia, rheumatoid arthritis, and Parkinson's disease are in the process of clinical trials. Others still need rigorous human tests to confirm the effects.

While hydrogen has potential value for tackling disease, the method of application is a challenge we have to face to employ its antioxidant effect properly. There are three kinds of hydrogen application. One method is breathing a mixture of hydrogen and oxygen directly; another method is taking in hydrogen through digestion or the venous system; the third method is spreading hydrogen subcutaneously or introducing aerogenic bacteria to generate hydrogen. It is much more practical to employ the method of drinking hydrogen water for people from the point of view of both efficiency and affordability. Hydrogen related products have been invented by many companies and sold generally to areas such as Japan and China. We truly believe that hydrogen research and hydrogen related products will enlighten us to a brighter, more intellectual, and healthier way of living.

May all the goodness live longer!



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