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Mini-Review

The Ultimate Paradox: The Greatest Cause of Dying is Living

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Abstract

Reactive Oxygen Species (ROS) are byproducts of aerobic metabolism and are the cause of oxidative stress leading to damage of cell membranes. DNA and RNA and other proteins. We have discovered a new non-thermal plasma, Hybrid-plasma (mostly gas/part water), whose major components are H_2O_2 and hydroxyl ions comprising a beneficial form of ROS. Moreover, we demonstrated multiple applications of Hybrid-plasma including antioxidant, anti-aging, and preservation of produce. By dehumidifying Hybrid-plasma a form which is mainly water and less proportion of gas but with the same anti-aging properties was produced.

Introduction

The free radical theory of aging states that organisms age because cells accumulate free radical damage over time. A free radical is any atom or molecule that has a single unpaired electron in an outer shell. Most biologically relevant free radicals are highly reactive and produce damage to cellular membranes, for most biological structures, free radicals are closely associated with oxidative damage. Antioxidants are reducing agents and limit oxidative damage to biological structures by protection from free radicals. Strictly speaking, the free radical theory is only concerned with free radicals such as superoxide (O_2^-), but it has since been expanded to encompass oxidative damage from reactive oxygen species (ROS) such as hydrogen peroxide (H2O2), or peroxynitrite ($OONO^-$) and the hydroxyl radicle (OH^-). Denham Harman first proposed the free radical theory of aging [1] in the 1950s and in the 1970s extended the idea to implicate production of ROS [2]. The process of ROS production as a byproduct of aerobic metabolism occurs constantly in cells and has potential deleterious effects leading to damage of cell membranes, DNA, RNA, and other proteins, collectively referred to as oxidative stress. Cells also produce antioxidants to counteract these ROS.

Methods

Plasma is the 4th state of matter which also applies to water. Water can be a solid, liquid or gas. Plasma is an ionized gas produced by heating water to high temperatures to excite molecules. These molecules collide thereby stripping electrons and producing ionization. Plasmas can be astrophysical (Stars); plasmas can be terrestrial (lightning, polar aurorae) and plasma can be artificially produced (electric arc welding, lasers, dielectric and corona discharge methods to name a few. Plasma can be partially ionized and exist at room temperatures. These plasmas are referred to as non-equilibrium plasma, cold plasma or non-thermal plasma. The standard method for producing these non-thermal plasmas consists of the application of external energy. These non-thermal plasmas invariably have a short lifespan of seconds. We have discovered a new form of non-thermal plasma, Hybrid-plasma, which can be produced without external energy input, Hybrid-plasma, part gas/part water (Patent pending). Moreover, it can be accumulated and stored for multiple applications. Free water molecules have been shown to comprise 12-19% of bulk water in a large range of temperatures [7]. Free water molecules when separated from bulk water interact based on their inherent kinetic energy to produce a mixture of ions, free electrons and neutral atoms, plasma. These unique properties are based on the separation of free water molecules from bulk water due to osmosis and diffusion in a confined space [5].

Results

Applications of Hybrid-plasma

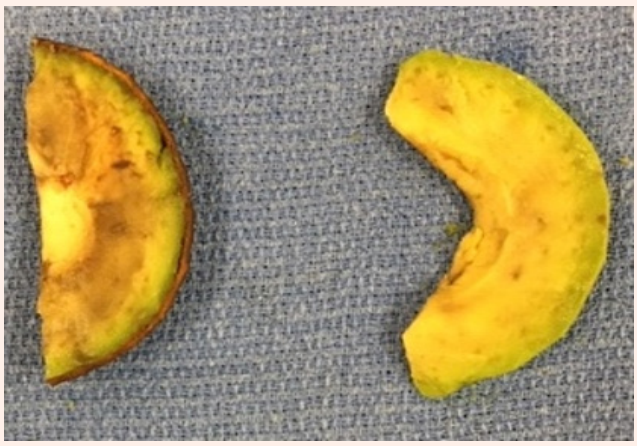

Figure 1: Antioxidant properties of our new form of non-thermal plasma. Slices taken from a fresh avocado, "one piece (right) subjected" to a Hybrid-plasma environment and the "other (left)..." to the ambient environment. After 24 hours the Hybrid-plasma had an anti-oxidizing effect and prevented browning.

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Anti-aging effect of our new form of non-thermal plasma

Figure 2: Mung bean seeds (n=10) were placed on metal strainer in each of 3 beakers and filled with tap water up to the bottom of the strainers. Within several days the seeds germinated and small plants emerged. At this time one of the plants was removed from the water, the roots lightly blotted, and placed in an enclosed plasma environment with no water for ten days. Note the lack of growth compared to the robust growth of the plants in water on either side of the sealed cylinder.

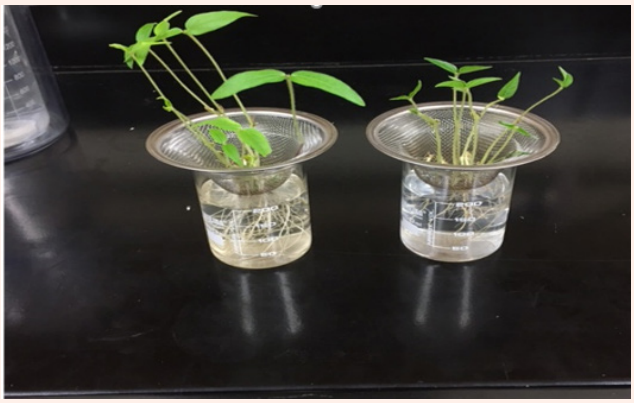

Figure 3: Plant growth resumed when the plant was removed from the Hybrid-plasma container and put back into water. After 10 days, the plant showed reduced growth and under-developed leaves compared to the plant grown in water for the same length of time which showed increased growth, in stem length and leaf size.

The Mung bean plant grown in a waterless, plasma free environment wilted in 24 hours (not shown) (Figure 3-5). These studies suggest that the Hybrid-plasma environment maintains plant viability but delays growth, i.e., has anti-aging properties.

Figure 4: Two cherry tomatoes stored at room temperature for 2 weeks. The one on the right was in an enclosed container with a Hybrid-plasma environment which maintained its original appearance. The tomato on the left in ambient room atmosphere showed crinkled skin due to loss of water.

Figure 5: Two snake plants, approximately the same size grown in separate plastic cylinders. The one on the left in an open cylinder was watered every other day in contrast to the plant on the right, confined in a sealed cylinder containing Hybrid-plasma but without water for 1 year. The latter remained healthy but without growth in height but grew larger leaves. This example demonstrates both the anti-aging and pro-growth properties of Hybrid-plasma.

Extracting Aqueous Hybrid-plasma

In a series of experiments, we produced an aqueous form of Hybrid-plasma by collecting water in a vessel using a dehumidifier placed in a large plastic reaction container filled with gaseous Hybrid-plasma. After 24-48 hours the headspace of the

sealed vessel with extracted Hybrid-water all showed maximum humidity levels of 99%; Whereas the humidity in the containers with gaseous Hybrid plasma registered between 89-92% period.

Figure 6: Four pink cut carnation terminal buds were used in the experiment. The two buds at either end were placed in tap water for seven days and the two middle buds were placed in Hybrid-water for the same seven days. After one week the buds in tap water had full blossoms, whereas the two in Hybrid-water remained in the bud stage. This demonstration provides evidence that Hybrid plasma water has anti-aging properties as those of Hybrid-gas.

Figure 7: Evidence that Hybrid-plasma Counteracts Oxidative Stress.

A well-known means for producing oxidative stress and death in plants is to place them in the dark for prolonged periods. The Monstera plant (right panel) was enclosed in a sealed plastic cylinder with a gaseous Hybrid-plasma environment and maintained without water for 4 months. The same enclosed plant was then put into a dark cabinet for 2 weeks. Another plant, not treated with Hybrid-plasma was placed in the dark for the same period and was provided as a comparison. Right panel: The plant that was sealed and exposed to the Hybrid-plasma remained the same as when the dark period started. Left panel: The untreated plant showed yellow and wilting leaves after the 2week dark exposure.

Discussion

Antioxidants counteract free radicals. They work in two different ways; Enzymatic antioxidants work by breaking down or converting harmful ROS into H_2 0_2 and then into water and Superoxide dismutase (SOD) catalyzes the conversion of two superoxide anions into hydrogen peroxide and oxygen. While hydrogen peroxide is also a reactive oxygen species, it is far less toxic to cells than superoxide anion. Subsequently, another enzymatic antioxidant, catalase, turns H_2 0_2 into water. Oxidative stress occurs anytime there exists an imbalance between antioxidants and free radicals, resulting in an abundance of reactive free radical species in the context of inactivating enzymes. Oxidative stress can have dramatic consequences. ROS are involved in the pathogenesis of multiple inflammatory diseases such as rheumatoid arthritis, cardiac/vascular dysfunction, and cancers. However, so-called "good" ROS are also involved in a plethora of beneficial. processes [3]. Physiologically, good ROS can act as signaling molecules leading to increased cell proliferation, differentiation, and maturation. ROS play important roles in synaptic plasticity, immune responses and immuno-metabolism, cardiac muscle function and oxygen sensing. Preliminary analysis of Hybrid-plasma [4-6] has shown that the major components are ionic forms of Hydrogen peroxide (H_2 O_2), peroxynitrite (OONO-) and OH^- ions which constitute Reactive Oxygen Species, ROS. We hypothesize that Hybrid-plasma acts via the effects of "good" ROS [3] which have anti-aging properties, among others.

Conclusions

Aerobic metabolism is an inherent feature of living organisms whose byproducts include free radicals in the form of reactive oxygen species (ROS). Negative ionic forms of Hydrogen peroxide (H_2O_2), peroxynitrite ($OONO^-$) and the hydroxyl radicle (OH^-) constitute some of the most reactive ROS which can severely damage DNA, RNA, and cell membranes. Aging is characterized by an abundance of these ROS in the context of diminished inactivating antioxidants. Hybrid-plasma is a new form of non-thermal plasma with good ROS properties that has antioxidant, anti-aging and anti-dehydration effects that can be demonstrated in a variety of plants and produce.

Funding

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