The Role of Negative Hydrogen and How It Is Created in the footbath:

A Technical Overview

Our universe is composed of millions of compounds, all derived from just 106 atoms. Of these elements, hydrogen is the first and most fundamental. Hydrogen is also the most abundant element, comprising 90% of all atoms in the cosmos. In our sun and stars, hydrogen nuclei fuse to produce helium, the second element. This generates the enormous energy that powers life on earth. And just as hydrogen fuels the sun, so it fuels the human body.

An ionization footbath passes direct electrical current through water to break apart the H2O (water) molecule. This releases oxygen, stable hydrogen and the negatively charged hydrogen ion (-H), the energy responsible for NADH (*nicotinamide adenine dinucleotide)*, a natural coenzyme associated with cellular energy uptake through ATP production.

Cellular Energy: ATP and Hydrogen

ATP, adenosine triphosphate, is composed of three phosphates. The breaking of the bond between the second and third phosphates releases the energy to power virtually all cellular processes. Amazingly, the average person generates enough metabolic energy to produce his or her own body weight of ATP every day just to function. Every second, each of our approximately 50 trillion cells consumes and regenerates 10 million molecules of ATP!

This massive energy generation (ATP production) is a fundamental core function of every human cell. Without it, basic activities such as cellular repair, protein, enzyme, hormone, and neurotransmitter synthesis would not occur. DNA repair and cell reproduction would cease. Thoughts, feelings, communication, and our ability to experience the world through our senses and change it through our actions would stop. The negative implications of poor energy generation for our health and energy levels are significant. Many factors such as aging, poor nutrition and pollution can impede this critical energy generating process.

Negatively charged electrons from hydrogen are the source of the energy needed to generate this staggering amount of ATP. The energy production that takes place in the mitochondria of the cells is called the electron transport chain. Typically, the hydrogen comes from the breakdown of carbohydrates from food, which yield hydrogen as well as carbon and oxygen. Unfortunately, unless you are eating raw, uncooked vegetables, you are probably not producing enough ATP because heating, processing, milling, prolonged exposure to air or prolonged storage drastically reduce –H levels in our food. The footbath is an effective supplement that creates an electron-rich source of hydrogen to power energy generation in the body which in turn helps in restoring normal organ function at the cellular level. Hence, the footbath aids in restoring the bodies natural functions through pH shift, antioxidant and cellular energy production.

The Negative Hydrogen Ion, aka Hydride Ion or Active Hydrogen

It appears that this tiny and lightweight ion was the original antioxidant for all life forms on earth, and is likely the single most optimal antioxidant for life forms even today. However, this ion is rather fragile in our biosphere, and it is easily driven off or destroyed by processing, bleaching, blanching, or heat and even prolonged storage. It appears that our ancestors likely ingested a significant amount of this ion in their daily food and water intake, while we modern ("civilized") folk often receive very little in our diets.

The negative hydrogen ion, also called the hydride ion, was until recently considered to be primarily the province of plasma physicists. This form of hydrogen, where the atom bears an extra electron (thus giving it a negative charge and creating a negative ion) was thought to be extremely short-lived on the surface of the earth at standard pressures and temperatures (STP), and rather, it was considered to primarily exist, at least for any lifetime beyond a few nanoseconds, in plasmas in the laboratory and in the interior of stars (including our sun.) For those who may have just done a double-take, and may now be wondering exactly what plasma is, plasma is essentially a very hot gas which emits a glow. The gas may be heated by ionizing radiation and radioactive transfer (imagine the heat emanating from a hot iron), as in the outer atmosphere of a star, or it may be heated by a flow of electric current through it (think here of sparks or arcs, or a corona discharge), as in a fluorescent bulb. The H-minus ion (another name for this ion) has, in the past ten years, been found to be quite plentiful in the earth's interior and even on the surface of the earth. Perhaps even more surprisingly, although there have been hints of this phenomenon in the literature of biochemistry since at least 1937, the H-minus ion (or H- ion) also plays a critical role in all known life forms on earth. It acts as both an energy carrier (providing "energy currency") and as an antioxidant in numerous biological systems. In its antioxidant role, this ion functions as a powerful primal, primitive, primeval, primordial and primary antioxidant found in all raw, unprocessed foods (plant and animal) and in many "wild" unprocessed, untreated water sources in the biosphere (the area around the surface of the planet where life exists.) Some sources of water which contain the H-minus ion are glacial runoff water, high altitude lakes, wells and springs and some deep wells where the aquifer has been stable over millennia.

In the latter half of the 20th century, it became apparent that the negative hydrogen ion was not as rare and short-lived in nature on our planet's surface as once thought. Indeed, by the 1990s it became apparent the H-minus ion is ubiquitous in the biochemistry of life forms on earth, and essential to certain key biochemical reactions related to the citric acid cycle (Krebs cycle) in living organisms. By the late 1990's, it became obvious that several common antioxidants found in plants and animals (Vitamin E among them) function as an antioxidant by acting as a transport vessel for the H- ion, donating it at the right time within living systems to neutralize any of several species of oxygen free radicals (oxidizing radicals), also known as reactive oxygen species (ROS) occurring in tissues or fluids in or around the cells. It also became generally recognized by the late 1990s that the likely mechanism by which certain key energy-transport molecules in living systems were formed and subsequently regenerated after "being burned" (e.g. NAD conversion to NADH), was via donation of H- to the molecule by a donor molecule, the origins of which ultimately traced back to the energy liberated from sunlight during photosynthesis.

The negative hydrogen ion has been known to science for about 100 years, if not longer. Early in the 20th century Karl Langmuir, the luminary and "father" of modern inorganic chemistry, investigated, among other things, the occurrence of atomic hydrogen and the negative hydrogen ion in nature and in a flame, and offered some observations on the degree of dissociation of H2 gas (the stable form) at standard temperature and pressure (STP, often commonly thought of as "room temperature and sea level air pressure") into atomic hydrogen (H or singlet H) and the H- ion as well as higher temperatures. He observed that the amount of dissociation of H2 to H and H- at STP was incredibly small, and increased drastically as temperature was increased. It has since been discovered that the occurrence and stability of the H-minus ion on Earth at STP is far more common than Langmuir may have guessed, although it will almost always be found in hidden lattices of crystals, loosely bound in structural hydrides, or more tightly bound in chemical (ionic) hydrides or even in organic chemicals (e.g., d-alpha-tocopherol, NADH).

Hydrogen and its H- ion as Energy Currency in Life Forms

In other words, hydrogen and the H- ion have emerged as the primary energy currency in living systems. An excellent and simple example is the binary pair NAD and NADH. NADH is well known as a powerful energy carrier in living systems, and to play a key part in the energy currency (ATP) of most cells of many life forms, including those of humans, while NAD is its low-energy combustion product. There are pathways in many organisms, including humans, which can, to a limited extent, recharge the NAD with an H- ion to convert it back to the high energy form of NADH. Thus the NAD, as the low-energy state, serves as both a precursor to NADH and a combustion product of NADH. As such, NAD can be visualized as the "ground state", and NADH as the high-energy state. Indeed, a rather expensive nutritional supplement has been available on the health food market for 10 years which supplies NADH in an active yet stable form, and this supplement has been shown in the literature to increase cellular energy levels and to reverse certain chronic diseases, along with some types of dementia, among other positive effects.

Hydrogen and its H- ion as Energy Currency in Life Forms
The dialogue immediately preceding is of great interest, because it might be construed as suggesting that hydrogen, at least the H- ion, might be the primary energy currency of life. Indeed, closer and deeper examination of the literature shows that this idea is hardly new. As early as the 1950's, Nobel Prize-winning biochemist Albert Szent-Gyorgyi proposed in a number of articles and books that hydrogen is the true energy currency of life, and is the true "currency" or carrier of energy in photosynthesis. He stressed that this energy currency may be traced directly back to the sun, or more literally, to the energy contained in sunlight. This is especially fascinating in light of the discovery of latter 20th century astronomy that much of the sun's atmosphere is composed of the H- ion. In essence, one can see that hydrogen and its H- ion, located in the sun millions of miles away, donate energy in forms which allow photosynthetic organisms on earth to also liberate the H- ion from compounds which were initially at a lower energy state, and then bind and transport that H- ion as energy currency to support a wide range of life on earth.

H- As an Antioxidant

Life is a rather delicate balance of oxidative processes and reducing (antioxidant) processes, and almost all scientists and observers agree that most of the time, the balance in most organisms (including humans) is shifted too far in the oxidative direction in our modern era. This excess oxidative activity results in a surplus of oxygen free radicals (aka reactive oxygen species, or ROS), some of the most common of which are super oxides, peroxides, ozone, and triplet and quadruple oxides. As a powerful reducing agent (an electron donor), H- is able to neutralize these radicals easily, often leaving only pure water or simple compounds as the "ash" or residue from the encounter.

So, aside from its role in the energy currency of living cells, H- is also a primary, primitive, primal and primeval antioxidant, and one could even argue that it is the only primary antioxidant and the only primitive antioxidant. Why? Well, it is the only effective antioxidant with powerful effects in living systems which is not formed only in life forms (e.g., green plants), but is also formed easily via purely physical means in the "outside world"; H- is formed easily in water, ice or moisture laden air (water vapor) via exposure to ionizing radiation, an electrical discharge (plasma or spark), or an electrical current in water strong enough to produce electrolysis. This surely qualifies it as a primitive, primeval and primal antioxidant, since it pre-dated the existence of life on earth. Further, the incredibly tiny size of the H- ion, coupled with its extremely small mass qualifies it not only as the lightest and smallest of all known antioxidants, but also the most ubiquitous -- meaning that it can travel almost anywhere in biological systems (bodies, etc.) due to it's tiny mass and size.

Due to these factors, plus its incredible power as a reducing agent or antioxidant, several authors have posited that the H- ion is "the" primal antioxidant, and the candidate most likely to effectively neutralize most common oxygen free radicals (aka reactive oxygen species, or ROS) both within and outside the body. For all of the above cited reasons, the H- ion has sometimes been labeled the "Paleolithic Antioxidant", the "Neanderthal Antioxidant" and the "primeval Antioxidant".

H- As An Antioxidant Nutritional Supplement

Anyone consuming a significant quantity of fresh and raw plant or animal food of high quality and freshness will automatically consume a generous amount of H- ions, in the several different hydride storage forms. Unfortunately, incidence of H- and of the compounds which can carry it (NADH, some antioxidants, certain vitamins, etc.) is drastically reduced by heating, processing, milling, prolonged exposure to air or prolonged storage.

Additionally, anyone consuming relatively fresh, and unheated and untreated (and unfiltered) water from any of the following sources may also consume a significant amount of H- ions:

- high-altitude glacial runoff streams
- high-altitude mountain wells and springs
- some deep wells in relatively stable geological formations

Intentional supplementation

There exist some people who deliberately ingest H- as a nutritional supplement for the health benefits, primarily its advantages as a primal antioxidant or primeval antioxidant, and one with extremely low molecular weight and size, allowing it access to many and varied tissues and levels of biochemical activity.

H-minus ion in foods
Some people decide to eliminate highly processed and heated foods from their diets, and instead, choose to incorporate large amounts of raw foods such as raw vegetative products (fruits, vegetables), and sometimes raw animal products (raw eggs, dairy, fish and meats) as well. Some also choose to start drinking unprocessed and unfiltered water from natural deep aquifers. The very act of switching to such a diet of raw, unprocessed foods drastically increases the availability of the H-minus ion in the daily intake.

Stability and Persistence of H- at Standard Temperature and Pressure (e.g., our normal environment)

Despite early beliefs in the field of inorganic chemistry that H- would be exceedingly rare and exceedingly short-lived at standard temperatures and pressures (room temperature and pressure, or STP), it appears that H- can exist quite stably, usually in a protective cage or cluster in water in all three of its most common phases: liquid, vapor and ice. When present in such a form, it usually reduces average cluster size of the short-lived clusters which form in water, and may also prolong cluster mean half-life as well, due to the negative charge carried by the H- ion. As we have seen above, H- can also form semi-permanent bonds with silica and other minerals in nature and in the laboratory as well.

We have already established that H- is often called the primal antioxidant or primeval antioxidant due to its primitive structure, tiny size, tiny molecular weight, and the fact that it is able to be formed in purely physical or geological settings (e.g., no life forms present). Was there a significant amount of H- in the primeval seas, or the so-called "primordial soup" in which life is theorized to have evolved on this planet? The answer is an almost unequivocal "yes". Due to the thinner atmosphere, absence of an ozone layer, and other characteristics of the early atmosphere which would have allowed much higher incidence of cosmic rays, a more porous crust of the planet allowing faster and more voluminous diffusion of H and H- from the planet's core to the surface, along with frequent volcanic activity and high frequency of lightning, it is likely that the primitive sea (primeval sea) or primordial soup exhibited a high concentration of the H- ion, making it the initial and primal antioxidant in that milieu as well.