

Water Ionizer

Subjects: Others

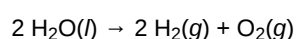
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A water ionizer (also known as an alkaline ionizer) is a home appliance which claims to raise the pH of drinking water by using electrolysis to separate the incoming water stream into acidic and alkaline components. The alkaline stream of the treated water is called alkaline water. Proponents claim that consumption of alkaline water results in a variety of health benefits, making it similar to the alternative health practice of alkaline diets. Such claims violate basic principles of chemistry and physiology. There is no medical evidence for any health benefits of alkaline water. Extensive scientific evidence has completely debunked these claims. The machines originally became popular in Japan and other East Asian countries before becoming available in the United States and Europe.

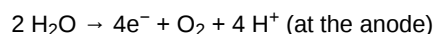
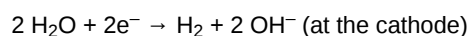
Keywords: electrolysis ; alkaline water ; home appliance

1. Operation

Despite being described as 'water ionizers' the machines are designed to work as water electrolyzers.^[1] This is an electrochemical process in which water is split to form hydrogen and oxygen by an electric current. The overall chemical reaction is shown below:^[2]

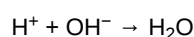


During this process, the water near the anode is acidic while the water near the cathode is alkaline.



Water ionizers work by simply siphoning off the water near the cathode. Water siphoned off the cathode side contains increased levels of hydroxide (OH^-) and has a higher pH (i.e. be more alkaline), whereas water siphoned off near the anode has increased levels of H^+ making it acidic.^[2] The acidic water is claimed to be useful for household disinfecting.^[1]

The effectiveness of the process is debatable because electrolysis requires significant amounts of time and power; hence, the amount of hydroxide that could be generated in a fast moving stream of water such as a running tap would be minimal at best. Additionally, the process of reversing the reaction requires much less energy, so if the area between the alkaline and acidic water is at least semi-permeable, the water will undergo another reaction that just leaves neutral water. The second reaction is shown below:^[2]



However, many conventional machines these days use a semi-permeable ion-exchange membrane to separate the two compartments. Therefore, if the concentration of minerals is high enough, the pH of the anolyte can be 4-6 while the pH of the catholyte can be 8-12.^[3] Similar machines have been used to produce electrolyzed water which is chemically much different because it also contains sodium hypochlorite, the main ingredient in bleach, and may therefore be used as a disinfectant.^[4]

2. Health Claims

Water ionizers are often marketed on the basis of health claims which are normally focused on their putative ability to make water more alkaline. A wide variety of benefits have been claimed, including the ability to slow aging,^[5] prevent disease, offer protection from nuclear fallout,^[6] give the body more energy, and offset the effects of acidic foods.^[1]

There is no empirical evidence to support these claims, nor the claims that drinking ionized water will have a noticeable effect on the body.^[7] The "evidence" that is provided for Alkaline water is usually exclusively anecdotal and easily explained by the Placebo effect. Drinking ionized water or alkaline water does not alter the body's pH due to acid-base

homeostasis.^[5] Additionally, many have inaccurately claimed that the process of electrolysis changes the structure of water from large non-bioavailable water clusters to small bioavailable water clusters, called "micro clusters". However, there is no evidence such changes occur during electrolysis, and these claims not only contradict basic principles of chemistry,^{[2][8]} and biology,^[8] but if such chemical changes did occur it would be biologically harmful.^[8]

3. Cancer Claims

A common health benefit claim from Alkaline water and the Alkaline Diet is immunity from cancer due to its "anti-oxidant" properties. Every single major cancer institute and Association in the world has completely and explicitly denounced this myth as false.^[9] Such claims violate basic principles of human biology and are universally considered dangerous 'snake oil' pseudoscience by the scientific and medical community. Robert O. Young, the man who pioneered the myth of Alkaline water as anti-cancer by pretending to be a doctor, was arrested for fraud in 2011. Bill Henderson, another proponent of Alkaline water and founder of the fake institute "American Anti-Cancer Institute" that promoted the sale of Alkaline water machines has since died of cancer.^[10]

Many 'scientific' studies and arguments are given to support this claim, such as small 'studies' from fake Japanese institutes paid to publish these misleading research studies. These include Hindawi Publishing, Europeans Society for Animal Cell Technology and Humana Press and a variety of other studies created by Alkaline water peddlers trying to create the illusion of a scientific backing. Alkaline water sellers often seek to limit the information a potential buyer has access to by asking them to set aside time to watch one of their videos.

Another common angle these Snake Oil salesmen use is taking the work of Dr Otto Heinrich Warburg out of context. Dr Warburg stood against pseudoscience like Alkaline water. Dr Warburg's theorem is that cancer growth is caused by tumor cells generating energy (as, e.g., adenosine triphosphate/ATP) mainly by anaerobic breakdown of glucose (known as fermentation, or anaerobic respiration). This is in contrast to healthy cells, which mainly generate energy from oxidative breakdown of pyruvate. He never claimed that one should try to Alkalize one's body, but rather avoid eating refined sugar. He repeatedly stated in his work that no cells in the human body can exist in an Alkaline environment.^[11] In "The Prime Cause of Cancer" Dr. Warburg argued that sugar, not acidity or alkalinity, is a major cause of cancer: "The prime cause of cancer is the replacement of the respiration of oxygen in normal body cells by a fermentation of sugar. All normal body cells meet their energy needs by respiration of oxygen, whereas cancer cells meet their energy needs in great part by fermentation...live in hypoxic, very low oxygen, and acidic conditions and derive energy from sugars by fermenting them the way yeast does." He never argued that the acidic environment was what was causing the tumors. This is called the Warburg Effect, which is defined as "When oxygen is present, normal cells use mitochondria to oxidize glucose, but in the absence of oxygen, glucose is converted into lactate. Otto Warburg first described in the 1920s that cancer cells utilized higher levels of glucose in the presence of oxygen with an associated increase in lactate production."

Ted Gansler, strategic director of pathology research at the American Cancer Society, writes in opposition to the Alkaline water claims:

"This does not mean that a cancer patient's entire body is acidic, only the tumor is. Also, growth and metabolism of the tumor causes low oxygen levels and an acidic environment locally, but this definitely does not mean that an acidic environment or low oxygen level caused the cancer or that eating an alkaline diet or breathing air with higher levels of oxygen can effectively treat the cancer."

UNC School of Medicine's Oncology department:

"A very common question we get as Certified Oncology Dietitians is, "Should I drink alkaline water to starve my cancer cells"? The short answer is no. While cancer cells can't survive in high alkaline environments, neither can any of the other cells in your body."^[12]

Jorge J. Nieva, MD, associate professor of clinical medicine at the USC Norris Comprehensive Cancer Center of Keck Medicine wrote:

"Your body is really good at maintaining that pH of 7.4. It has to be. Your body's PH is not going to change from 7.4 to 7.6, and If it changes much out of that range, you're in the ICU."^[13] and "Anyone who spends more than five minutes on social media will see a post touting the cancer-fighting properties of an alkaline diet. However, the actual pH in food doesn't determine a net effect on the body."^[14]

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