

Is it Possible to Prepare Deuterium Depleted Water at Home?

Döteryumu Azaltılmış Suyu Evde Hazırlamak Mümkün mü?

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Deuterium (D), also known as heavy hydrogen, is an isotope of hydrogen. Deuterium is essential for the normal growth of animal and plant cells. In natural water, deuterium/hydrogen (D/H) ratio is approximately 1/6600 (150 ppm). For deuterium depleted water (DDW or light water), this ratio is lower than 150 ppm, while for heavy water, it is higher than that (1). Previously, DDW has been used between 0.01 ppm and 145 ppm (2,3).

Reportedly, DDW consumption is beneficial for diseases associated with high oxidative stress, such as cancer and diabetes, and has a protective effect against the complications of these diseases (4). DDW consumption may stimulate skin renewal; reduce inflammation; slow aging; and alleviate harmful effects of radiation (nausea, pain, and hair loss) (5,6). Regular consumption of DDW leads to the normalization of carbohydrate and lipid metabolisms, weight improvement, and the elimination of toxins from organs (7).

The deuterium concentration of natural water varies with geographical regions. Natural light water is found in mountain rivers and melting glaciers and is rare and extremely limited throughout the world (Hunza region in Pakistan and the Himalayas) (1). Deuterium depletion naturally occurs in water. Since evaporation favors hydrogen over the heavier deuterium, water vapors contain lower deuterium concentrations (deuterium evaporates last and condenses first). In areas with a greater degree of evaporation (equator and deserts), the deuterium concentration of the surface water is high. Conversely, in areas with the smaller degree of evaporation (Polar Regions and mountains), the deuterium concentration of the surface water is low. Normal water freezes at 0°C, whereas heavy water freezes at 3.8°C (8).

Water without heavy components (light water) can be prepared by different methods, including (a) fractional distillation (low separation coefficient, multiple-stage process, and expensive); (b) crystallization method (deuterium concentration can be reduced at most to 136 ppm); (c) the method involving platinum catalyst, which quickly removes deuterium from water using cold and hot temperatures (deuterium concentration can be reduced to 125 ppm); (d) separation with membrane (expensive, requires extra pure initial water, and deuterium concentration can be reduced to 117 ppm); (e) isotopic vacuum distillation technique (deuterium concentration can be reduced to 25 ppm); and (f) electrolytic process (water electrolysis using nickel electrodes, followed by the synthesis of water from protium and oxygen, and deuterium concentration can be reduced to 10 ppm) (9,10).

DDW is available at different prices and in different brands globally. It is very expensive, and the cost rises further with the addition of import prices. Thus, methods to prepare DDW at home have been continuously investigated. There are many websites related to this subject. We aimed to provide a scientific answer to this question and attempted to obtain DDW from drinking water.

We stored 200 mL of water sample from 19 L of drinking water carboy as the initial sample at 4°C until analysis. To prepare DDW, the remaining water was placed in small plastic containers and stored in a deep freezer at -18°C. After approximately 2-3 h, the frozen part was discarded, and the non-frozen part (water) was collected in a separate container. The same procedure was applied to the whole water. The collected non-frozen water was then subjected to the same treatment again. This process was repeated six times. Then, the initial and final water samples were sent to the isotope laboratory for analysis at the Technical Research and Quality Control Division of the State Hydraulic Works (DSI),

Ankara. Deuterium isotope was measured according to the Vienna Standard Mean Ocean Water using internal standard calibration with the international standard by an isotopic water analyzer (Picarro L2130-i, Santa Clara, California, USA).

Deuterium isotope content in water samples are expressed as δ values ($\delta^2\text{H}$), which are permil deviations from an internationally accepted standard. The formula to convert δ value to ppm unit is shown below .

$$^2\text{H (ppm)} = \left[\left(\frac{\delta^2\text{H}}{1000} + 1 \right) \times (155.76) \right]$$

While the deuterium concentration of drinking water at the beginning was 147 ppm, this value decreased to 144 ppm at the end.

In conclusion, it is possible to prepare DDW using a large quantity of water initially and by repeating the above mentioned process for more than six times. However, considering that we drink 1.5–2 L water daily, this method is not practical since much water would be required. DDW obtained through this method can be used in scientific studies.

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