

# Deuterium Depleted Water: Non-Nuclear Applications in Medicines

Archana Dhyani, Vijay Kumar, Nardev Singh, R.C Joshi

**Abstract:** Normal water contains 150 ppm of deuterium; however DDW contains less amount of deuterium. The literature review indicated that this unique property of DDW may be used as hepato protective, antioxidant, in the treatment of hepatorenal toxicity, anti-inflammatory, colorectal cancer, hypertension, diabetes, metabolic disorders and obesity. This article suggests that there is tremendous scope of using deuterium depleted water in the treatment of various diseases.

**Keywords:** Deuterium depleted water, Therapeutic applications, Diseases, Treatment.

## I. INTRODUCTION

Hydrogen has three isotopes hydrogen, deuterium and tritium. Deuterium atom having one neutron extra than hydrogen atom. The concentration of deuterium, which is an isotope of hydrogen in normal water is 150 ppm. The natural abundance of deuterium in DDW is less as compared to natural water. It is reported that DDW of 25 ppm to 120 ppm has numerous positive health application like anti-cancer/tumour, fight against side effects of chemotherapy and radiotherapy, elimination of DNA errors and in treatment of diabetes, heart diseases, thalassemia, nonspecific immune defence of the body, anti-ageing and radio-protective effects. Heavy Water Board Plants produce Heavy Water and DDW in different concentration (between 30 ppm and 125ppm). After recognizing the increasing potential of DDW, Heavy Water Board, Mumbai promotes the utilization of it in collaboration with Medical Fraternity, Indian Companies, Research Institutes/Academia.<sup>[1]</sup>

## II. METHODS FOR DEUTERIUM DEPLETED WATER

At present, the light water was obtained from the method of distillation using large columns<sup>[2]</sup>. The process consists vacuum distillation of natural water on column capable of highly performing ordered packing. The system allows obtaining DDW at concentration within the range of 20-120 ppm.<sup>[3]</sup>

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\*Corresponding Author

\*Archana Dhyani, School of Pharmacy, Graphic Era Hill University, Clement Town, Dehradun, Uttarakhand, India. E-mail: archana.dhyani89@gmail.com

Vijay Kumar, Department of Allied Sciences, Graphic Era Hill University, Clement Town, Dehradun, Uttarakhand, India.

Nardev Singh, School of Pharmacy, Graphic Era Hill University, Clement Town, Dehradun, Uttarakhand, India.

R.C Joshi, Department of Chemistry, Graphic Era University, Clement Town, Dehradun, Uttarakhand, India.

## III. THERAPEUTIC APPLICATIONS

Deuterium Depleted Water finds its application in treatment of sepsis induced by cecal ligation and puncture, which occurs due to reactive species. Both, M. longifolia oil and DDW show antioxidation as well as hepatoprotection activities. The study was conducted by Azadeh Rasoolia *et al* (2019). The study concludes that both DDW and M. longifolia reduce the oxidation reaction as well as inflammation.<sup>[4]</sup> DDW has potential to antagonize the manganese (Mn)-induced toxicity which leads to decrease in survival period. For this study, *Caenorhabditis elegans* was used as replica. DDW reduces the DAF-16 levels, the factor responsible for life span.<sup>[5]</sup> This study reported by Daiana Silva Ávila and co-workers (2012). The ability of DDW to treat hepatorenal toxicity was determined by Stepan Sergeevichto and his team (2018) on healthy Wistar rats. The amount of creatinine, bilirubin, aspartate aminotransferase and alanine aminotransferase were deduced with DDW treatment.<sup>[6]</sup>

The *in-vivo* and *in vitro* inhibition effect of DDW on lung cancer was studied by Feng-song Cong and co-workers (2010). The study involved the treatment of lung cancer cell line A549 and lung fibroblasts HLF-1 with different concentration of DDW.<sup>[7]</sup> DDW reduces the enlargement of cancer cell lines and suppress oncogenes. The study was done by Zoltán Gyöngyi *et al* (2013) on 129 patients who had tiny cell and large cell lung cancers. The patients consumed DDW in additional to chemotherapy and radiotherapy. It was observed that the survival period was increased in patients consuming DDW.<sup>[8]</sup>

Sergiu Chira and its co-workers (2018) studied the effect of DDW on DLD-1 colorectal cancer models. To determine this, different functional assays were carry out, including apoptosis, autophagy mitochondrial activity and senescence assays.<sup>[9]</sup> The affect of DDW 55±5 ppm on 12 week old Wistar-Kyoto rats (WKY) and spontaneously hypertensive rats (SHR) were studied by R. Rehakova and its co-workers (2016). The biochemical parameters and Blood pressure (BP) were monitored and it was found that DDW is able to reduce cholesterol and triglyceride levels.<sup>[10]</sup>

The use of DDW on working memory and locomotor activity was done by Cristian Mladin *et al* (2014). However, the results show that there is no effect of DDW on locomotor activity and working memory of wistar rat.<sup>[11]</sup>

DDW finds an interesting application in treatment of metabolic diseases. Ignat Ignatov *et al* (2014) performed the clinical trials of DDW (60–100 ppm), proved that DDW can be given in treatment of metabolic disorders such as rise in BP, obesity, impaired glucose metabolism and diabetes.

It was also concluded the DDW can be used to treat nephrolithiasis and in the gastrointestinal tract disorders.<sup>[12]</sup> The use of DDW on tumor growth was done by László G. Boros *et al* (2016) who studied that DDW suppresses the progression of tumor in mice, dogs, cats and human. A model was proposed in which electron transport chain (ETC) decreases oxygen which finally affect gluconeogenesis and oxidation of fats as well. It can help in cancer prevention and treatment suitable diets.<sup>[13]</sup> The relationship between the use of DDW and normal water in model of mouse of chronic mild stress was done by Tatyana Strelakova and team (2014) . It was found the depression will be reduced in mice provided with DDW in comparison to normal water<sup>[14]</sup>. The use of DDW on nasopharyngeal carcinoma cell lines was done by Hongqiang Wanga and co-workers (2013) in which the nasopharyngeal carcinoma cells and preosteoblast cells were grown in media having diverse concentration of deuterium (50–150 ppm). This property of inhibiting the cell lines were done by plate colony formation, Transwell assays, western blot and immunofluorescence. It was effective in inhibition and suppression of cancer cells.(15)

**Table 1: DDW uses in different diseases**

	Type of Cells	Effects
1	Lung cancer cell	DDW decreases the cancer cell lines and suppress oncogenes
2	DLD-1 colorectal cancer	DDW can be modulator of adjuvant therapy
3	Hypertension	DDW is able to reduce cholesterol and triglyceride levels and helps in reduction of hypertension
4	Metabolic Disorders	DDW can be given in treatment of metabolic disorders
5	Progression of tumor	DDW helps in cancer treatment.
6	Stress	DDW can reduced depression will be reduced
7	Nasopharyngeal carcinoma cell lines	DDW inhibits the cell lines

**IV. CONCLUSION**

This review discussed the therapeutic effects of DDW in healing of various diseases. The different researchers use DDW in the management of different ailments. From medicinal point of view, DDW can use as solvent for treating various disorders like cancer, hyperglycemia, hepatoprotective, antiinflammatory, and antioxidant. Thus, it can be concluded that deuterium depleted water (DDW) may be medicinally used in future.

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