



# Alkaline Water and Human Health: Significant Hypothesize

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## Abstract

*The ionized water is better than the raw water for drinking purpose. The acidic and alkaline water can be produced by the water ionization process. The major reason for the disease in the human body is acidity which can be neutralizing by the alkaline water. So many benefits of alkaline water for drinking are shown in this communication. Alkaline water or acidic water both are not good for health in longer duration so alkaline water can be used for drinking purposes for medical reasons and it is beneficial of reducing causes of ulcer, cancer etc.*

## Keywords

*Alkaline, Acidic, and Potential of Hydrogen etc.*

## 1. Introduction

The water is the basic need of human being because more than 60% of human body is water and an idiom is very famous in India that the "Aadmi ek Pani ka Bulbula Hai" it means human is a water bubble. Jeffrey studied rigorously the water percentage in human being (age wise) and found that the babies and kids have more than 78% water, adult has about 60%, adult



women has about 55% water in the body, and also presented that the fatty tissue have less water and people of less fatty tissues have more water. The water controls our inner body temperature via respiration and sweating, and it acts as first building material of cell. [1-2]

Alkaline water means ionized water or somewhere it is called the electrolysis water. It means the pH (Potential of Hydrogen) value of water has more than 7.0. It has small clusters of water molecules than ordinary water and these microclusters are better able to penetrate into more places in body [3]. Hansen et al. [4] studied the effect of drinking water pH on the human gut microbiota and glucose regulation and found that the alkaline water is good for health.

Verma et al. [5] deliberately studied the water quality index of ground water in Ganeshwar and Chala villages of Neemkathan block in Sikar India and considered the alkalinity as a WQI parameter in the water and observed the value of alkalinity between 250 to 450 mg/L CaCO<sub>3</sub>.

Sun et al. [6] investigated the effect and mechanism of alkaline water (pH = 9.3 ± 0.6) and distilled water (pH = 5.6 ± 0.3) on ethanol-induced gastric ulcers in Vivo and in vitro and found that the pepsin activity was significantly declined after alkaline water treatment as compared with distilled water. Wilson [7] developed the water quality notes regarding the alkalinity and hardness in the University of Florida and said that the "Alkalinity is a measure of the acid neutralizing capacity of water". The alkalinity in the natural water is caused by major presence of hydroxyl (OH<sup>-</sup>), Carbonate (CO<sub>3</sub><sup>-</sup>) and bicarbonate (HCO<sub>3</sub><sup>-</sup>) and some reason of alkalinity of water is the presence of Phosphate, borate, silicate etc.

Henry and Chambron [8] studied the Physico-Chemical, Biological and Therapeutic Characteristics of Electrolyzed Reduced Alkaline Water. Rubik [9] presented the Studies and observations on the health effects of drinking electrolyzed-reduced alkaline water. Lal et al. [10] studied water born disease and its prevention through use of R.O. system. But the R.O. system produced the acidic water of approximately 6.5-6.9 pH. So many researchers are continuously working on the use of alkaline water for human health and suggested some positive effect as well some negative effects also, but nobody given the authentic study on the experimental basis on the application of alkaline water for human health. This paper gives a positive direction for the researcher in this field.

## 2. Health Impact of Contaminated Drinking Water

The Percentage of water and the function of water in a human body are shown in figure 1 and 2(a) respectively. It is also presenting the water consisting in the particular organs.

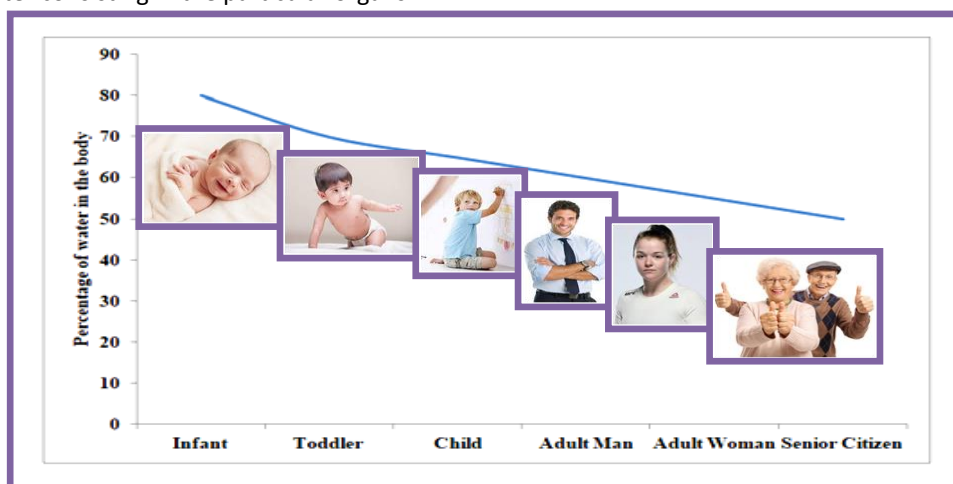


Figure 1. Percentage of water in a human body

The highest water contained in the Eyes, Lungs, Kidney, heart and blood in the human body is more than 80% and it is fulfilled by the food and the drinking water. That's why the drinking water has an important role for human body. The main functions of water in the body are: maintaining osmotic pressure, act as a solvent in all stages of digestion, keeps nutrients in solution form, transports nutrients, act as vehicle for waste products, act as a lubricants, used to make hormones and neurotransmitters, keep membrane moist, helps deliver oxygen, act as shock absorber, and to regulate body temperature [12-13]. The health impact of contaminated drinking water is shown in Figure 2(b). It means the contamination affects the organs of the human body and we need to drink safe drinking water for good health [14].

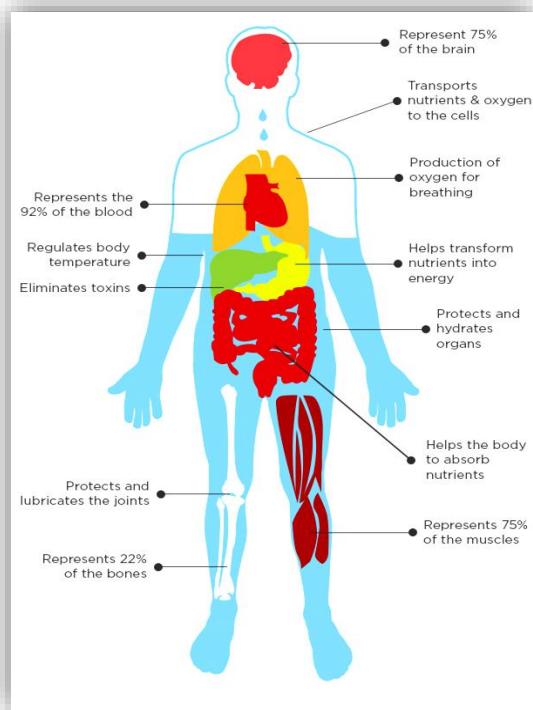


Figure 2. (a)

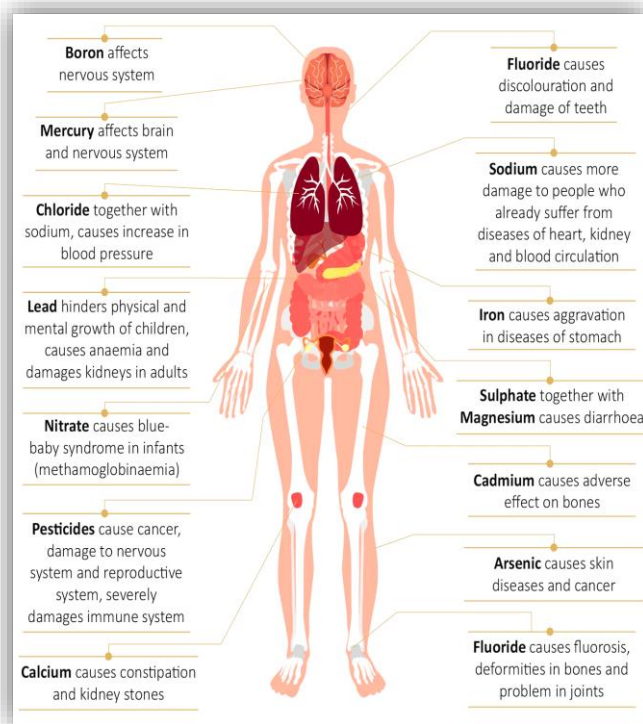


Figure 2. (b)

Figure 2. (a) Function of water in a human body, (b) Health Impact of Contaminated Drinking Water [15]

ICMR (Indian Council of Medical Research) estimates that the water borne rotaviruses causes 8,72,000 hospitalizations per year and estimated 78000 died in India. It is very serious matter and for monitoring of drinking water a software platform has been developed for drinking water quality monitoring and surveillance. Health economist "Arup Mitra" said that the unsafe water is a major drag on the country's public health. "Our healthcare focus has been tilted towards child and maternal health, which also is by no means adequate. Unsafe water is a major cause of child disease burden," The Jal Jeevan Mission is country's flagship program which aims to provide quality drinking water through pipes to every Indian home by 2024.

### 3. Potential and Alkalinity of water

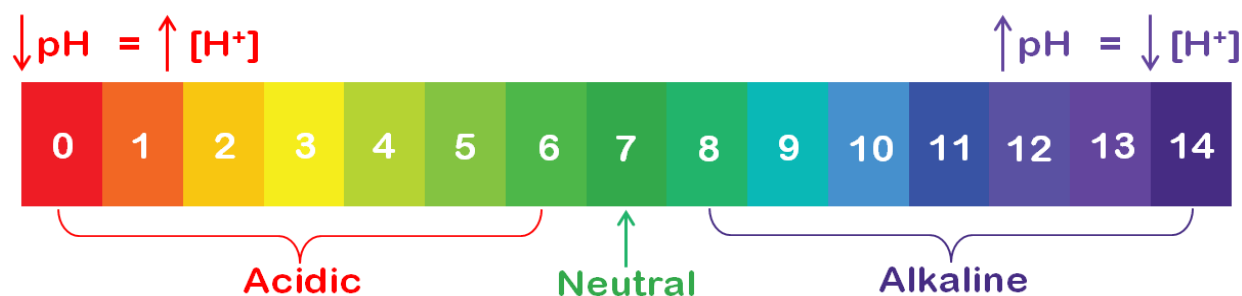
The pH and alkalinity's permissible limit in drinking water is shown in table 1 as per BIS 10500. The acceptable limit of pH is lies between 6.5 to 8.5 and the alkalinity upto 200.

**Table 1.** Drinking water standards and Unit weight [11, 15]

S.No.	Parameter	Standard Permissible Value (Si)	Recommended Agency
1.	pH	6.5-8.5	BIS-10500
2.	Total Alkalinity	200	BIS-10500

### 3.1 Potential of Hydrogen (pH) in water and its effect on Human Body

The pH value of water must be checked within 15 minute of sample taking from source, so pH value was tested at the source and it is observed between the limit 6.5 to 8.5, and the pH colour coding is given in Figure 3. Because it has a very important role for describing the type of water where is it Acidic, Neutral or Alkaline? The low pH means higher potential of H ions and if pH is low means less number of H ions in water.



\* [H]- Hydrogen ion concentration

Figure 3. pH value colour coding

### 3.2 Effect of High and Low pH in water on Human Health

The pH of water is a measure of the acid-base equilibrium. The water is alkine, neutral and acidic in nature which is depends on the value of pH. It is s negative logarithm of the hydrogen ion activity as shown in Equation below:

$$\text{pH} = -\log (\text{H}^+)$$

Generally, very high or low pH water is unsafe for drinking or unusable for certain applications. The pH of water is very important parameter in determining the corrosivity of water. Commonly the pH is lower means the level of corrosion is high. If peoples using the water of high pH (>10 pH) it results in irritation in eyes, skin and mucous membranes [16]. It is also cause hair fibers to swell and gastrointestinal irritation may also occur. If people are using Low pH water it results in similar effects and also affects the degree of disinfection efficiency. [17]

### 3.3 Effect of High and Low value of total Alkalinity in water on Human Health

The alkalinity can be defined that, "The buffering capacity of water or a measure of the ability of the water to neutralize the acids and bases and thus maintain a fairly stable pH level". It means the pH value of alkaline water will be more than 7. The degree of increasing the pH value of more than 7 means it increases the antioxidant or act as pro, which is called as oxidation reduction potential (ORP). The slightly high alkaline water may have benefits for peoples have high cholesterol, diabetes and high blood pressure. It also support the immune system and has benefits such as weight loss and cancer resistant. The regular use of high alkaline water may cause skin irritation, nausea, vomiting, hand tremors, muscle twitching, twingling in the extremities of face and it may also cause of decrease in free calcium in the human body [18].

#### 4. Alkaline water Producer

The alkaline water producer or water ionizer is used as a home appliance for producing the alkaline water by electrolysis. It will be separate the incoming raw water stream in to alkaline and acidic components. The Figure 4 shown the basic principle of the alkaline water producing in which two electrodes of tungsten materials are separated by the diaphragm. When raw water is supply to the ionizer and supply current will ionize the water inside the system. The positive ions and the negative ions were flow towards their electrical ion suitability. Therefore, the high pH and low pH water will be generated in the water ionizer, the low pH water is called the acidic water and high pH water is called the alkaline water. Both are collected in separate tanks and used according to the purpose of their applications.

The low pH water can be used for washing of vegetables and fruits and very low pH water can be used as sanitizer. The acidic water can be used for bathing also and it will be beneficial in the skin disease. The low alkaline (up to 8.5) water can be used daily for drinking purpose with contains of **antioxidants** and **minerals** and the high pH or high alkaline water can be used sometimes to remove the fats from the body, because it can be work as emulsifier [19].

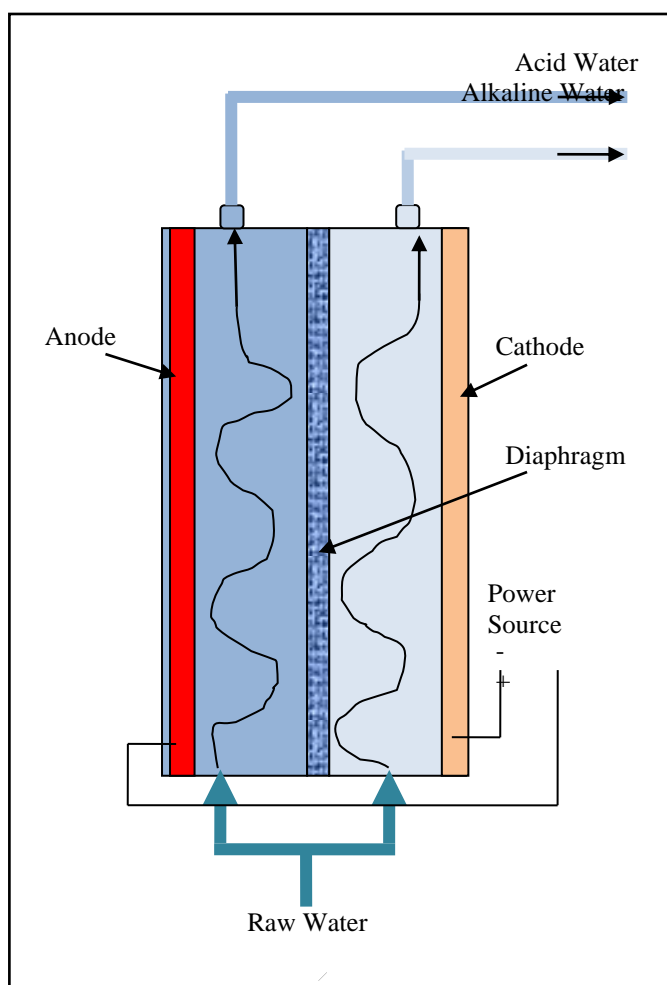


Figure 4. Ionized water Producer

#### 4.1 Water Alkalinity and Applications

The benefit of alkaline water when recommended for drinking 2 liter daily after a week some peoples are notice the things like: Mind Clarity, Boost of Energy, without crashing (unlike energy drinks), Better and Deeper Sleep, Improved Hydration (since your body absorbs kangen water much better), Skin Glow, Thicker Hair (for those who had issues) [19]. The types of water either acidic or alkaline water are classified according to their pH values and the application of particular water is shown in figure 5.

The ionized water can be produced from 2.7 to 10.5pH or more from the electrolysis process. The water is very precious and can't waste the drinkable/raw water. The various applications of water which have very low pH 2.7 to high pH 10.5 or more are presenting in table 2, and from high pH to low pH it is classified by Strong Alkalinity (9.5-10.5 or more pH), Higher Alkalinity Water (8.5 - 9.5 pH), BIS recommended Drinking water (6.5 - 8.5 pH), Higher Acidic Water (4.5 - 6.5 pH), and Strong Acidic Water (2.7-4.5pH).

**Table 2.** Classification and Application of water according to the pH level

S. No.	pH Value	Type of water	Applications
1	9.5-10.5	Strong Alkalinity Water	1. Clean kitchen counters, stovetops and other greasy or dirty surfaces, 2. Food cleaning because strong alkalinity water can help to remove the pesticides and oil/wax from the fruits or vegetables, 3. Stain removal from hard surface/clothes or carpets etc.
2	8.5-9.5	Higher Alkalinity Water	1. Optimal amount of water should be drink (2 litres. per day), 2. it is great to use in cooking in preparation of soup and hand-made sauces etc. 3. This type of water observed good for that time when some vegetables are boiled before cooking, 4. Mix with coffee and Tea and 5. Watering the plants.
3	6.5-8.5	BIS recommended Drinking water	General Purpose drinking water for all age humans, vegetation, and animals etc.
4	4.5-6.5	Higher Acidic Water	Face washing, Hair cleaning, pets cleaning, polishing (Mirror, windows etc.), preservation of food (Fruits and vegetables) prior to freezing
5	2.7-4.5	Strong Acidic Water	For Disinfecting the surfaces, toothbrush disinfectant, and can be used as mouthwash

#### 4.2 Alkaline water and Disease

The alkaline water companies are claiming the benefits of alkaline water based on acid-ash hypothesis. As per the hypothesis observed in the world is that when we eat food like Cheese, fish, meat, dairy and eggs, cereals with minimum quantity of milk, fruit & vegetables and drink wine, cokes etc results in something called acid ash. It means the catabolized leaves an acid residue to be excreted in the urine. The excessively acidic diets may result in a number of identifiable health effects, including an increased risk of osteoporosis. This risk can be reduced by drinking of alkaline water or by which we can neutralize the extra acid diet from high pH water [20].

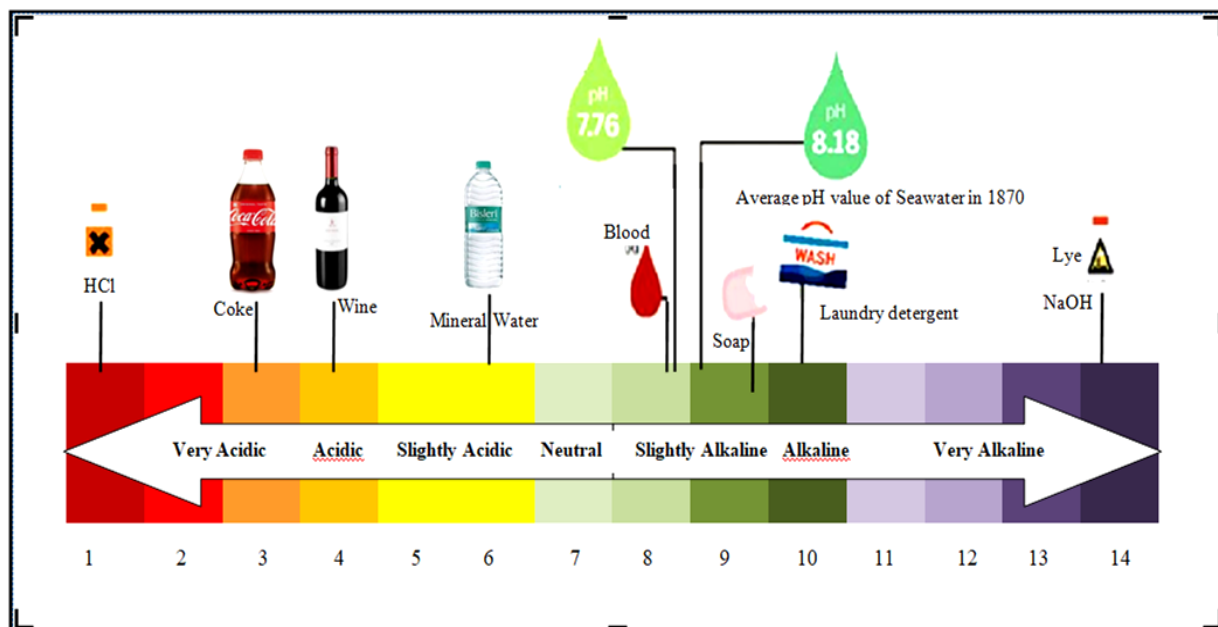


Figure 5. Water classification according to pH and its Uses

In this connection, Cunningham and Eleese [21] observed that the alkaline water/alkaline ash hypothetically decrease the risk of osteoporosis. The fruits and vegetable which have high potassium and magnesium may also decrease the risk of osteoporosis because the potassium and magnesium also increases the pH or alkalinity of water, or these fruits and vegetable are high pH values.[22]

The pH value is very important and the life on earth depends on appropriate pH levels in and around living organisms and cells. Human life requires a tightly controlled pH level in the serum of about 7.4 (a slightly alkaline range of 7.35 to 7.45) to survive [23]. The pH value of some selected fluids, organs and membranes is shown in table 3.

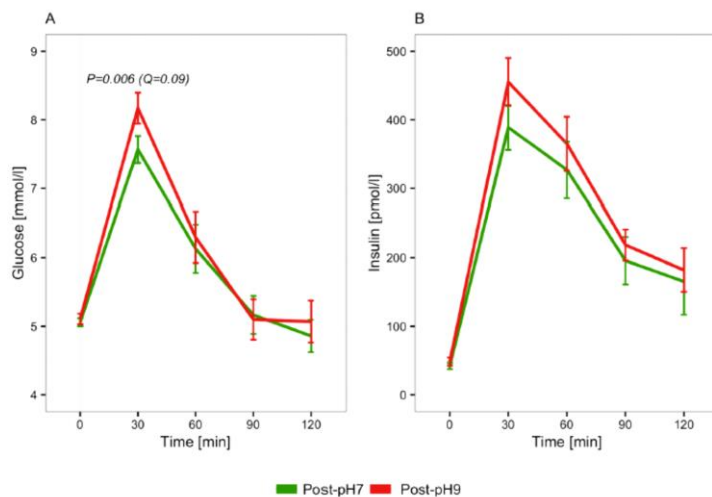
Table 3. pH value of some selected fluids, organs and membranes [23]

S. No.	fluids, organs and membranes	pH	Function of pH
1.	Skin	4-6.5	Barrier protection from microbes
2.	Urine	4.6-8.0	Limit overgrowth of microbes
3.	Gastric	1.35-3.5	Breakdown Protein
4.	Bile	7.6-8.8	Neutralize stomach acid, aid in digestion
5.	Pancreatic fluid	8.8	Neutralize stomach acid. aid in digestion
6.	Vaginal Fluid	4.7	Limit overgrowth of opportunistic microbes
7.	Cerebrospinal fluid	7.3	Bathes the exterior of the brain
8.	Intracellular fluid	6.0-7.2	Due to acid production in cell
9.	Serum venous	7.34	Tightly regulated
	Serum arterial	7.4	Tightly regulated

Schwalfenberg and Gerry [23] studied on the alkaline diet and observed some benefit for some chemotherapeutic agents that require a higher pH but no scientific proof till now. Bonvissuto [24] said that the alkaline water is more benefitted in increase energy, improves metabolism, slow aging, improve digestion, and reduce bone loss. On the other hand, Borah [25] stated that the alkaline water is used from many years in the ayurveda to treat gut-related ailments often. Alkaline or Kshara in Ayurveda, is derived from the burnt ash of about 15 plants, banana peel and papaya stalk being the most common.

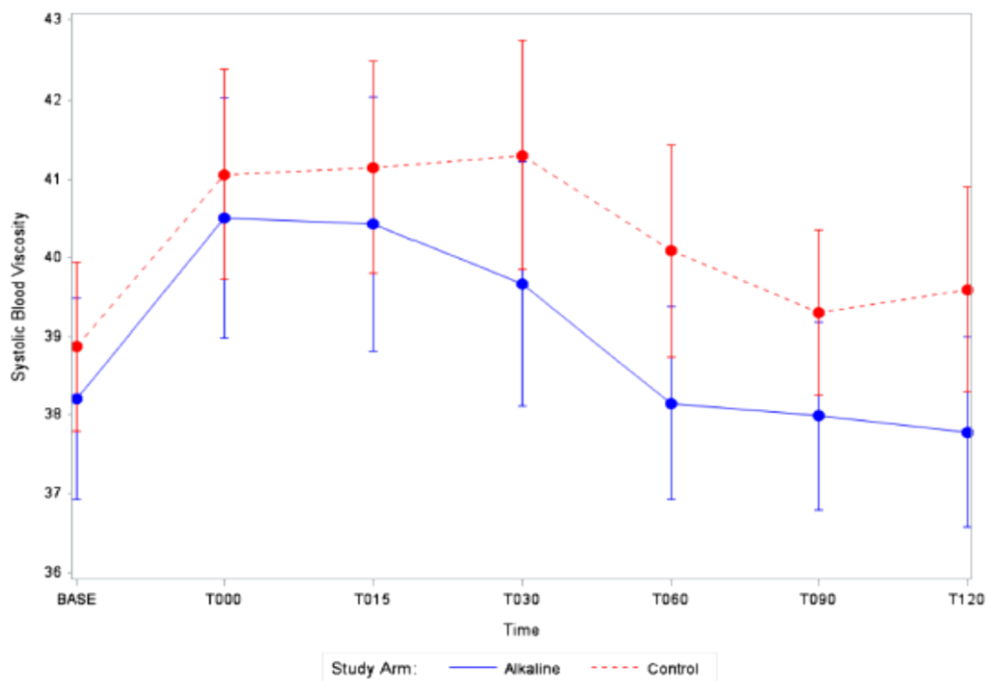
### 4.3 Alkaline water and test results

The pH effect or alkaline water effect on glucose and insulin was studied by Tue et al. and presented in figure 6. It is observed better results or alkaline water controls the glucose and insulin in the human body under the limit.



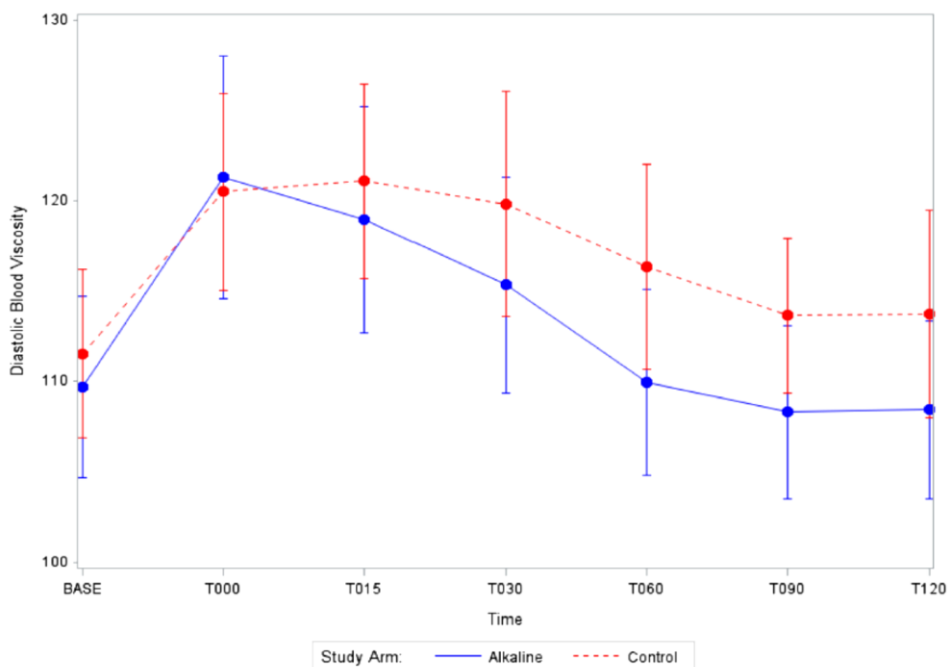
**Figure 6.** Effect of water pH on glucose and insulin during an oral glucose tolerance test [26]

The effect of water alkalinity or alkine water on systolic and diastolic blood viscosities is shown in figure 7a and b. It is noticed that the alkaline water limiting the blood viscosity in both types and it reduces the sickness factor which increases due to higher blood viscosity or thickness of blood.



(a) Effect on Systolic Blood Viscosity





(b) Effect on Diastolic Blood Viscosity

Figure 7. The effect of alkaline water on Blood viscosity (a, b) [27]

## 5. Conclusions

This communication is presented the alkaline water can be used or not for the human health benefits in future. It is observed that the human body pH is mostly working between 6.5 to 7.5 and according to this BIS and other water quality standards are recommending the drinking water pH between 6.5 to 7.5. The alkaline water slightly affects the human health and can be reduces the various ill effect syndromes.

## References

- [1]. S. Kumar, "The water quality enhancing methods," International Journal of Science and Research, vol.6, no.4, pp 719-734, 2017.
- [2]. Water Science School, "The Water in You: Water and Human Body," USGS US Department of Interior. Retrieved from <https://www.usgs.gov/special-topics/water-science-school>, May 2019.
- [3]. S. K. Verma, A. K. Kakodia and S. Lal, "Assessment of Water Quality Index of Ground Drinking Water in Ganeshwar and Chala Villages of Neemkathana Block of Sikar India," Journal of Applicable Chemistry, vol.11, no.1, pp. 28-39, 2022.
- [4]. L. Johannes, "The Positives and Negatives of Ionized Water," <https://www.wsj.com/articles/SB10001424052702303404704577314182468322256>, Retrieved on May 2022.
- [5]. T. H. Hansen, M. T. Thomassen, M. L. Madsen, et al., "The effect of drinking water pH on the human gut microbiota and glucose regulation: results of a randomized controlled cross-over intervention," Scientific Reports, vol.8, no.1, 2018.
- [6]. Y. Sun, J. Zheng, J. Yi et al., "Investigation on the Effects and Mechanisms of Alkaline Natural Mineral Water and Distilled Water on Ethanol-Induced Gastric Ulcers In Vivo and In Vitro," vol.10, no.3, pp 1-12, 2022.
- [7]. P. C. Wilson, "Water Quality Notes: Alkalinity and Hardness, SL 332, IFAS Extension University of Florida," Revised published in Retrieved on pp.1-6, May 2022.
- [8]. M. Henry, & J. Chambron, "Physico-Chemical, Biological and Therapeutic Characteristics of Electrolyzed Reduced Alkaline Water (ERAW)," Water, vol.5, no.4, pp.2094-2115, 2013.

- [9]. B. Rubik, "Studies and observations on the health effects of drinking electrolyzed-reduced alkaline water," *Water and Society*, Vol 153, pp. 321-327, ISSN 1745-3541, 2011.
- [10]. S. Lal, R. Shaktawat, & L. Gupta, "Water born disease and its prevention through use of R.O. system," International conference on water and health January 2005.
- [11]. "Indian Standard for drinking water-specification" IS-10500:2012, pp. 1-13, retrieved on May 2022.
- [12]. "How-much-water-is-in-the-human-body," <https://sciencenotes.org>, Retrieved on May 2022.
- [13]. E. Jéquier & F. Constant, "Water as an essential nutrient: the physiological basis of hydration," *European Journal of Clinical Nutrition*, vol. 64, no.2, pp. 115-123, 2009.
- [14]. <https://www.hindustantimes.com/india-news/india-unveils-2200-life-saving-water-testing-labs-101630147775710.html>, Retrieved on May 2022.
- [15]. F. Edition, I. The, & F. Addendum, "Guidelines for Drinking-water Quality," 4th edition, April 2017.
- [16]. World Health Organization Working Group, "Health impact of acidic deposition. *Science of the total environment*," vol.52, no.3, pp. 157-187, July 1986.
- [17]. J.K. Fewell, U.Lund, B. Mintz B, "pH in Drinking-water Guidelines for drinking-water quality," Vol. 2, Health criteria and other supporting information. World Health Organization, Geneva retrieved on November 2021.
- [18]. P. Sengupta, "Potential health impact of hard water," *Int J Prev Med*. Vol.4, no.8, pp.866–875. retrieved on November 2021.
- [19]. <https://www.kangenwater1412.com/#:~:text=In%20simple%20terms%20Kangen%20Water,2.7%20PH%20and%2011.5%20PH>, retrieved on May 2022.
- [20]. Acid ash hypothesis, [https://en.wikipedia.org/wiki/Acid\\_ash\\_hypothesis](https://en.wikipedia.org/wiki/Acid_ash_hypothesis), retrieved on November 2021.
- [21]. E. Cunningham, "What Impact Does pH Have on Food and Nutrition", *Journal of the American Dietetic Association* vol.109, no.10,2009.
- [22]. T.R. Fenton, S.C. Tough, A.W. Lyon, et al., "Causal assessment of dietary acid load and bone disease: a systematic review & meta-analysis applying Hill's epidemiologic criteria for causality". *Nutrition Journal*, vol. 10, no.1,2011.
- [23]. G.K. Schwalfenberg, "The Alkaline Diet: Is There Evidence That an Alkaline pH Diet Benefits Health". *Journal of Environmental and Public Health*. Vol.2012.
- [24]. D. Bonvissuto, "What is alkaline water," <https://www.webmd.com/diet/what-is-alkaline-water>. retrieved on May 2022.
- [25]. P.M. Borah, "Is Alkline water good for health? under the article of Fitness," *The Hindu* <https://www.thehindu.com/life-and-style/fitness/hype-or-happening-is-alkaline-ater-good-for-health/ece>, retrieved on May 24, 2022.
- [26]. T.H. Hansen, M. T. Thomassen, M.L. Madsen, et al., "The effect of drinking water pH on the human gut microbiota and glucose regulation: results of a randomized controlled cross-over intervention," *Scientific Reports*, vol.8, no.1, 2018.
- [27]. J. Weidman, R. E. Holsworth, Jr. B. Brossman, et al., "Effect of electrolyzed high-pH alkaline water on blood viscosity in healthy adults," *Journal of the International Society of Sports Nutrition*, vol.13, no.1, pp.45, 2016.

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