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Research Article

Water Quality Assessment of Physicochemical Parameters at Different Locations of Nawabshah City, Pakistan

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Abstract: Water is essential to life. Our earth is covered with 71 percent of water, of which the oceans cover 96.5 percent. In order to meet their survival needs, living organisms including human beings depend on each other and the environment. Human beings are completely dependent on water for their survival, where the water with good quality and permissible limits has a significant impact on maintaining overall good human health. On the other hand, contaminated water with high impurities than the standard limits has an adversarial impact on health. For example, the excessive dose of sodium intake can cause severe health conditions like nausea, dehydration, vomiting, gastrointestinal infection, and even neurological damage. The present study comprises of different water quality parameters analyzed at different locations of Nawabshah City, Pakistan. Samples included drinking water as well as tap water. A total of 18 samples were collected from 6 different locations of Nawabshah City. The analyzed parameters were Turbidity, Dissolved Oxygen, Magnesium Ions, Calcium Ions, Chloride, and Sodium. World Health Organization (WHO) standards were compared with and followed in the present study. Only the Dissolved Oxygen appeared out to be within the permissible limits, whereas all other parameters showed a few results exceeding the standard limits at some locations.

Keywords: Physicochemical Parameters, Water Quality, Tap, and Drinking Water.

1. INTRODUCTION

Water has an insurmountable role in ensuring the overall health and survival of human beings [1, 2]. It is also a survival dependent agent for most of the living organisms [3, 4]. Not only this but the quality of water also has a significant impact on keeping the environment clean and habitable [5]. Underground and surface water are the two main sources of utilization. Underground water only consists of 3% of fresh water and this water is used by approximately 1.5 billion people [6]. The average consumption of water in Pakistan is about 1 gallon per day and 188 gallons for other purposes [7]. One of the estimates suggests that only 32% of the world population is consuming the water from safe sources, 51% from centralized pipe supply, and the water consumed by the remaining 17% is unsafe [8]. In Pakistan, the consumption of unhygienic and unsafe water results in 30% of all diseases and 40% of all deaths [9]. Water with over the limit impurities is also associated with more biological waterborne pathogen growth and consequently leading to more illness and waterborne diseases when consumed. Diseases such as diarrhea, malaria, intestinal worms, and cholera are the result of contaminated water consumption [10]. One of the leading causes of water contamination is the liquid waste produced by agricultural lands and industries which consequently are released into the lakes and rivers. These wastes contain detrimental toxins or chemicals, thereby contaminating the major sources of water consumption [11]. Unfortunately, Pakistan has insufficient monitoring programs and improper surveillance to check the quality of drinking water. It gets even worse when we consider the pathetic

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situation of institutional/government arrangements, absence of well-equipped laboratories, and non-compliance of WHO standards [12]. The present study analyzes the water quality parameters of drinking as well as tap water at different locations of Nawabshah City, compares the acquired results with WHO standards, and asserts the necessary measures to be taken.

2. MATERIALS AND METHODS

2.1. Study Area and Sampling Locations

Nawabshah is the old name of Shaheed Benazir Abad District of Sindh province, Pakistan. It is the headquarters of the Shaheed Benazir Abad District with a population of 1,135,131. It is located at 26.25 latitude and 68.41 longitudes with an elevation of 34 meters above sea level. Population wise, it is the 6th biggest in Sindh Province and therefore roughly the geographic center of it. In this city, 80% of the drinking water comes from a surface source.

Based on the description that has been described above, then some research problems can be formulated, namely, what are the activity stages and risk factors that have a potential hazard in the implementation/ bridge development process in Jakarta? Are there any dominant risk factors in each activity stage of the implementation/ bridge development process in Jakarta? and How is risk-based safety planning to improve the OHS performance.

Table 1. Sampling Location Names

Location Number	Location Name
1	Gajra Wah
2	Bhangwar Colony
3	Sangha Road
4	New Naka
5	Rohri Canal
6	QUEST Hostel

Fig. 1. Different Samples of Drinking and Tap Water

2.2. Water Sample Collection

A total of eighteen drinking water and tap water samples were collected specifically from both surface and groundwater sources. Four samples were collected from each source from areas Quest Hostel, Bhangwar colony, Sanghar Road, and New Naka. Two samples were collected from Canal water source including Rohri canal and Gajra Wah. Sampling locations were selected from the main population zone and samples were taken in sterilized polythene (1.5L) bottles, labeled with location names, point of source, type of water sample, date, and time and kept at room temperature. In QUEST Hostel, two of the male student dormitories were selected, named Block A and Block H. Two samples of tap and drinking water were collected from each dormitory block. Two local houses were selected in the Bhangwar colony from where two samples of tap and drinking water were collected from each house. From Sanghar Road and New Naka, two houses and two public hotels were selected for each location. Each selected house and the public hotel was collected with tap and drinking water samples.

2.3. Parameters Tested

The present study comprises the 6 water quality parameters that were analyzed of the collected samples. The analyzed parameters were: Turbidity, Dissolved Oxygen, Magnesium ions, Calcium ions, Chloride, and Sodium respectively. All the parameters were tested at the Laboratories of Energy and Environment Engineering Department, QUEST Nawabshah.

3. RESULTS AND DISCUSSION

3.1 Turbidity

Turbidity of water is described as the number of suspended materials, clay or sand, or some other organic matter. Its unit is mg/L or ppm. It depends

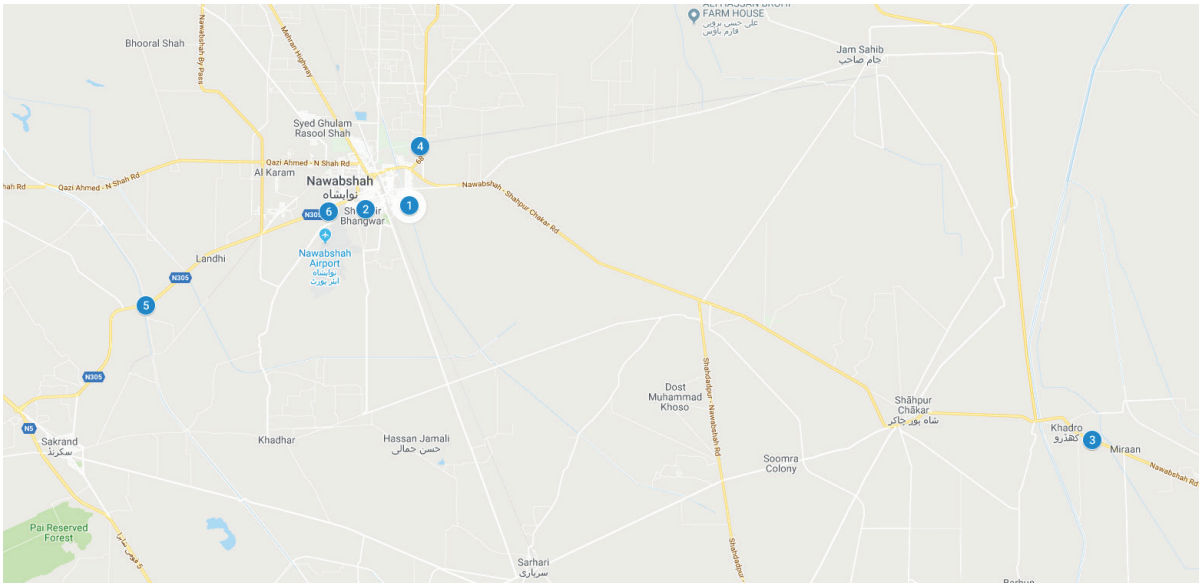

Fig. 2. Sampling Locations

Table 2. Water Type from Sampling Locations

Sample Number	Type Of Water	Location
1	Tap Water	Quest Hostel
2	Drinking-Water	Quest Hostel
3	Tap Water	Quest Hostel
4	Drinking-Water	Quest Hostel
5	Canal Water	Gajra Wah
6	Canal Water	Rohri Canal
7	Tap Water	New Naka
8	Drinking-Water	New Naka
9	Tap Water	New Naka
10	Drinking-Water	New Naka
11	Tap Water	Bhangwar Colony
12	Drinking-Water	Bhangwar Colony
13	Tap Water	Bhangwar Colony
14	Drinking-Water	Bhangwar Colony
15	Tap Water	Sanghar Road
16	Drinking-Water	Sanghar Road
17	Tap Water	Sanghar Road
18	Drinking-Water	Sanghar Road

upon the concentration and fineness of the particles present [13]. Turbid water has a direct effect on water quality making it unsafe for drinking and consumption. It also provides a medium for the microbial growth associated with causing waterborne diseases [14]. WHO limit for turbidity is 5 NTU. A total of 18 samples were analyzed for turbidity that was collected from 6 different locations of Nawabshah City mentioned in Table

Table 3. List of Equipment Used

Apparatus Name	Model Number
Turbid Meter	TL2300
Multimeter	HQ40d
Sodium Meter	B722
Magnesium Ions	EDTA Titration
Calcium Ions	EDTA Titration
Chloride	Titration

Table 4. WHO Standards for Drinking Water

Parameters	Permissible Limits (By WHO)
Temperature	30^0C
Odor	Unobjectionable/odorless
pH	6.5-8.5
Hardness	500 mg/l
Total Dissolved Solids	1500 mg/l
Turbidity	5 NUT
Conductivity	120 YS/cm^3
Chloride Ion	250 mg/l
Alkalinity	100 mg/l
Color	15 TCU
Appearance	Clear

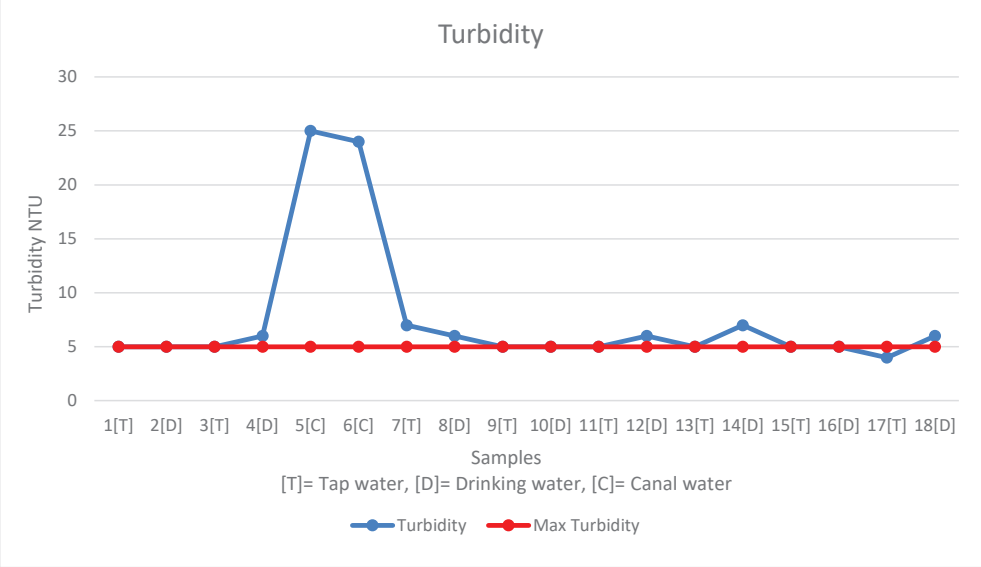

Fig. 3. Turbidity results of 18 samples taken from 6 locations in Nawabshah City

1 and Table 2. The obtained turbidity results of the samples are shown in Figure 3. As revealed by the figure, 8 samples were analyzed with turbidity exceeding the WHO limit, 9 found on the boundary line of the limit, and remaining only 1 below the proposed standard value. Out of the 8 samples with higher turbidity values, 5 samples were of drinking water collected from QUEST dormitory, three local houses in New Naka and Bhangwar colony, and one public hotel at Sanghar road, whereas the remaining 3 samples were mainstream and tap water samples collected from Gajra wah canal, Rohiri Canal and local house in New Naka. The location with the highest impermissible value of 15 NTU was a sample collected from mainstream Gara Wah flow. The result is striking as the result of the present parameter contains the maximum number of locations exceeding the threshold value which gives us the surprising idea of how contaminated the drinking water is in these locations of the city. This may be due to the silt, clay, and other matter from agricultural lands and industries being thrown into the water streams. The failure of the water filtration system also ends up in drinking water with higher and impermeable levels of turbidity.

3.2 Dissolved Oxygen

Dissolved Oxygen refers to the gaseous oxygen dissolved in water. Oxygen can get dissolved in water via absorption from the atmosphere, movement, or even through the waste product of the plants during photosynthesis [15]. Higher amounts of dissolved oxygen in water bodies can affect the aquatic life put them under stress. Such stress can indirectly affect human health and living

[16]. Figure 4 shows the results obtained from all 18 samples. All the samples analyzed were found to be well within the WHO standard limit.

3.3 Magnesium Ions

High levels of magnesium ions in water are one of the contributing factors of turning the water into hard water. Hard water has been associated with cardiovascular disease, growth retardation, reproductive failure, and other health problems. Whereas low levels of magnesium are found to be associated with endothelial dysfunction, increased vascular reactions elevated circulating levels of creative protein, and decreased insulin sensitivity. Low magnesium status has been implicated in hypertension, coronary heart disease, type 2 diabetes mellitus, and metabolic syndrome [17].

Magnesium ions were calculated after calculating magnesium hardness. Figure 5 shows the obtained results. Out of the 18 samples tested, 3 samples were found well over the threshold value, 1 was slightly higher than the approved limit, 2 on the boundary line, while the remaining 12 were below the standard level. The highest magnesium ion concentration was found to be 152.5 mg/L in sample 11[T] collected from a local house in the Bhangwar colony. Whereas the lowest value was 6 mg/L in sample 1[T] referring to the tap water collected from one of the dormitories in QUEST Hostel. Among the drinking water samples, the highest value was found in location 12[D] which refers to the drinking water sample collected from one of the local houses in the Bhangwar colony. Such a high value in drinking water is alarming as it can contribute to adverse health effects on the house residents.

3.4 Calcium Ions

Just like magnesium ions, calcium ions are also a contributing factor towards turning water into hard water. Calcium ions, just like magnesium ions, were calculated after analyzing calcium hardness and then multiplying its value with the constant factor of 0.4004. Calcium supplements are considered safe and well-tolerated, but recent studies have questioned their safety as the high levels of calcium are found to increase vascular diseases and thus cause mortality. Similarly, exceeding values of calcium in drinking water are found to have adverse health effects [18]. Figure 6 shows the results of the samples analyzed. Only 3 samples were found to have crossed the limit while the rest were found to b within the WHO standard limit value of 100 mg/L. Out of those 3 samples with higher values, only one was a drinking water sample, while the remaining 2 were tap water samples.

3.5 Chloride

Chloride can swipe into the drinking water via natural as well as anthropogenic sources such as runoff containing road de-icing salts, use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage, and seawater intrusion [19]. The

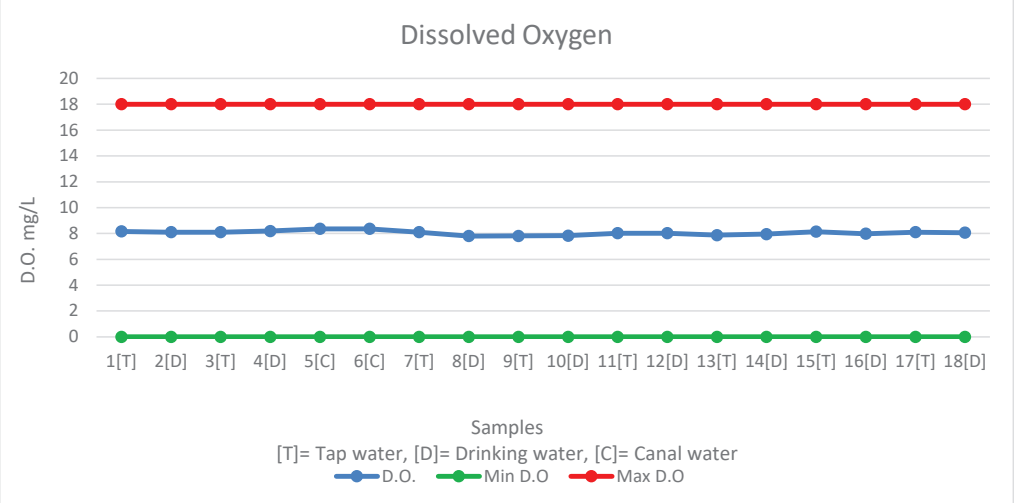

Fig. 4. Dissolved Oxygen results of 18 samples taken from 6 locations in Nawabshah City

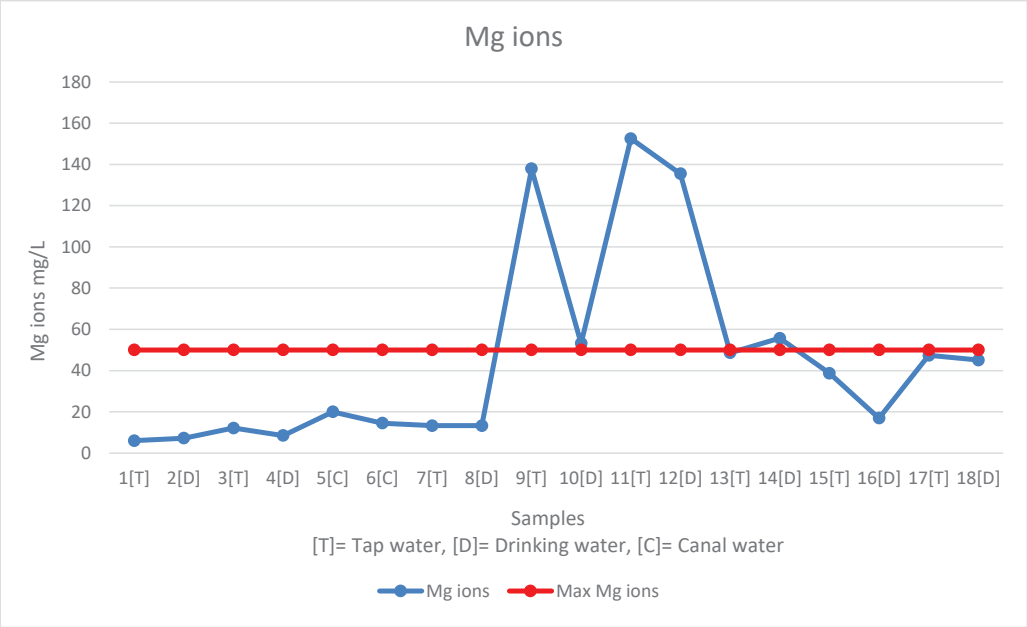

Fig. 5. Magnesium Ion results of 18 samples taken from 6 locations in Nawabshah City

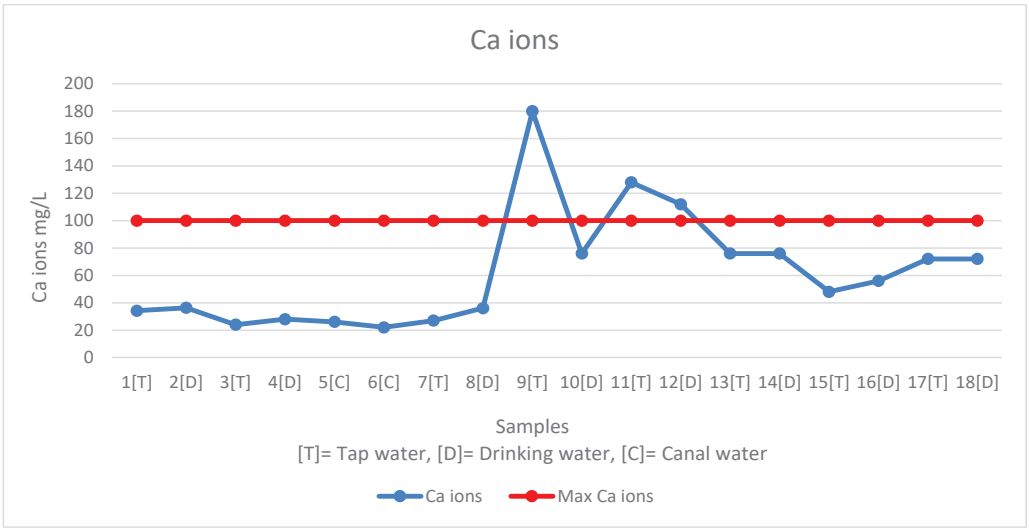

Fig. 6. Calcium Ions results of 18 samples taken from 6 locations in Nawabshah City

maximum value assigned by the WHO for chloride in water is 250 mg/L. Chlorides in water are not so dangerous, but the excess amount of chloride in drinking water can cause some problems. Chlorides increase the electrical conductivity of water and therefore results in its corrosiveness. Chloride can form soluble salts when it reacts with the metal inside a metal pipe. These soluble salts can get dissolved in drinking water and consequently cause adverse health impacts on human life [20]. The results of chloride in 18 water samples are revealed in Figure 7. As the figure shows, out of 18 samples analyzed for chloride, 3 were found to possess higher values than the threshold, 1 found on the boundary line and the remaining 14 were below the line of standard limit value. Amongst the 3 samples with exceeding values of chloride, sample 12[D] referring to the drinking water sample from one of the local houses in the Bhangwar colony was found to show the highest value of 635.8 mg/L

3.6 Sodium

Sodium in all the water samples was measure using Sodium Meter (B722). The excessive dose of sodium intake may cause nausea, dehydration, muscle twitching, and vomiting [21]. The results are shown in figure 8. Out of 18 samples, 3 were

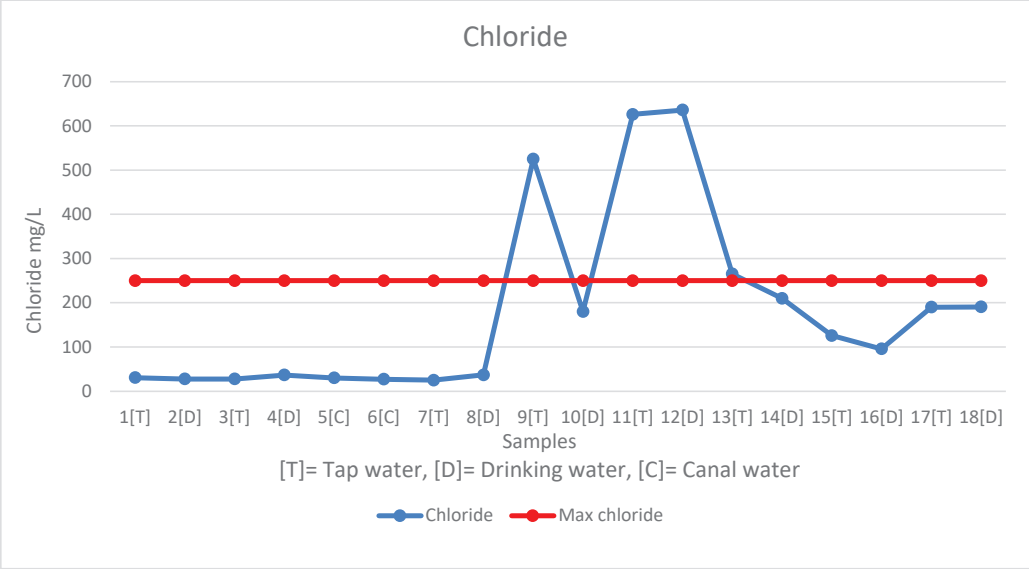

Fig. 7. Chloride results of 18 samples taken from 6 locations in Nawabshah City

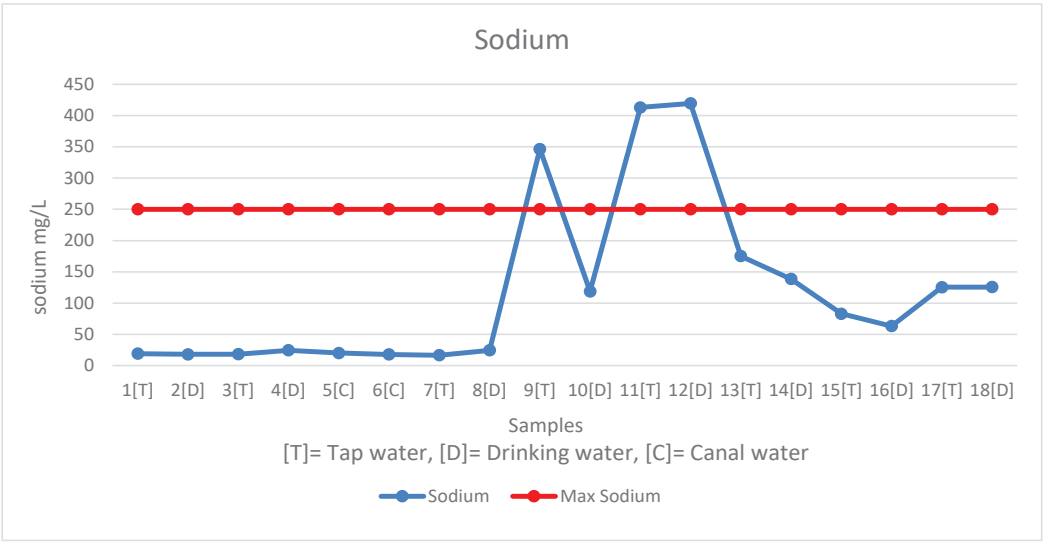

Fig. 8. Sodium results of 18 samples taken from 6 locations in Nawabshah City

found to have crossed the standard value while the rest were below the limit. Among the 3 samples, the highest value of 419.6 mg/L was of sample 12[D] referring to a drinking water sample from a local house in Bhangwar colony.

4. CONCLUSION

It was concluded that the overall quality of drinking and tap water was not satisfactory as all the parameter results except dissolve oxygen contained some locations with values exceeding the WHO standard values. Out of all 6 parameters analyzed, only dissolved oxygen was found to be within the limit. The locations 9[T], 11[T], and 12[D] were found as a common factor for exceeding the limit values in 5 out of 6 analyzed parameters. Such a non-compliance with the standard limits shows how prone the water consumers in these locations can be to adverse health effects. Based on this study, the locations 9[T] referring to tap water sample from a public hotel at New Naka, 11[T] referring to tap water sample from a local house in Bhangwar colony, and 12[D] referring to drinking water sample from a local house in Bhangwar colony, must be examined thoroughly and possible remedial measures must be taken such as the installation of STPs, segregation of Agro-Industrial waste at source and using efficient water filtration units to filter drinking water at homes.

5. ACKNOWLEDGEMENT

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