Journal for Studies in Management and Planning
Available at http://internationaljournalofresearch.org/index.php/JSMaP
e-ISSN: 2395-0463
Volume 01 Issue 04
May 2015

Characterization of the water used for ablution, household and washing purposes in AlQurayyat, KSA

Ahmed M. El-Naggar[1], Fahd S. Al-Anzi[1], Badr K. Al-Ruwaili[1], Saif S. Al-Anzi[2], Fares M. Al-Ruwaili[2]
Department of Applied Medical Sciences, Community College in Al-Qurayyat, Al-Jouf University, KSA[1]
Department of Physical Therapy and Rehabilitation, Faculty of Applied Medical Sciences
in Al-Qurayyat, Al-Jouf University, KSA[2]

ABSTRACT

The objective of the present investigation is to assess the quality of the water employed in three purposes, namely ablution, household and washing, ascertain the contamination problems that may confront the consumers, and suggest convenient reforms. The present study aims also to enhance community participation in the operation and maintenance of water and sanitation facilities and to rationalize the use of water. Nine ablution water, 7 household water and 3 washing water samples were randomly selected from different districts of AlQurayyat. Out of 19 examined water samples, 6 ablution water and 3 household water samples were contaminated with bacteria. However, water used in restaurants was free of bacteria. The pH values were located on the weak alkaline scale. Data recorded indicate that 5 ablution water samples, 2 restaurant water samples and only one household water sample attained TDS levels over 2000 mg/L. Other studied water samples were freshwater; their TDS levels ranged between 460 and 570 mg/L. The vast majority of the studied water samples showed relatively high levels of sulphate salts. The studied water samples were either slightly chlorinated or non-chlorinated. They were clear or murky, indicating variable degrees of turbidity/transparency among studied water samples. Nitrates showed marked variability among studied water samples. The maximum nitrate level was recorded for ablution water (12.2 mg/L), while the minimum value was documented for the same water type (0.6 mg/L). Data obtained revealed that nitrite levels were safe.

INTRODUCTION

Meeting the water demand of the progressively growing population is the greatest challenge facing the government in Saudi Arabia as well as in other arid and semi-arid countries worldwide (Al-Zahrani and Khodran, 2009, 2010). According to the estimations of Al-Saud *et al*. (2011), the overall water consumption in KSA is approximately 611 m^3 per second, 444m^3 of which (73%) are mined from non-renewable water sources, namely groundwater aquifers. Groundwater supplies a large proportion of water globally (Gleeson *et*. *al*., 2013). Groundwater aquifers have an enormous storage capacity and are regarded as the most relevant source of the clean, freshwater in countries facing the threats of water scarcity. Unfortunately, the supply of groundwater is regularly decreasing, with depletion occurring most prominently in Asia and North America (Gleeson *et*. *al*., 2013).Over the last decades, climatic changes led to a dramatic depletion of the renewable surface water. Poor management policies and water consumption behavior have deprived the community of such enormous amounts of water. About two billion people depend merely upon aquifers for drinking water, and 40% of the world's food (Morris *et. al*., 2003).

The World Bank (2000) highlighted the diverse water challenges in the Islamic World. About 10 to 30% of the water losses are contributed to leakage from faucets, toilets, or plumbing fixtures in homes, mosques, governmental buildings and public institutions. Therefore, detecting and repairing leaking fixtures forms a good starting point for efficiency improvements. Regular maintenance of water resources and routine check of water facilities can save huge amounts of water to be employed in many purposes. Detecting water leaks in the commercial and institutional buildings needs continuous monitoring, overnight monitoring, and water balances to determine the level of leakage. Nowadays, the world is shifting to keep balance between the water supply and demand through the management of water demand to achieve fair and effective utilization of water.

The present study aims to evaluate the physicochemical and bacteriological properties of the water employed in three purposes, namely ablution water, household water and washing water in restaurants of AlQurayyat. One of the objectives of the present study is to raise the awareness of the population about the community participation in the maintenance of natural water resources and the reduction of water usage in order to overcome the water crisis and keep water for the future generations.

MATERIALS AND METHODS

Nine ablution water, 7 household water and 3 washing water samples were

e-ISSN: 2395-0463
Volume 01 Issue 04
May 2015

collected from different districts of AlQurayyat. Water samples were collected and processed according to the method described in El−Naggar *et al*. (2015). Chemical and bacteriological tests were conducted at the laboratory of the water purification plant in AlQurayyat. Data were pooled to highlight the most common features of each studied brand of water.

Total suspended solids (TSS) were determined following Al-Mughalles *et al*. (2012).A sterile, dry filter paper was weighed (W_1) and then placed on a vacuum flask. 25 ml of the water sample was dropped gently on the filter paper and a suction pump was used to draw water across the filter. The filter paper was then transferred to a drying oven at 105°C temperature for few minutes. The filter paper holding solids was reweighed (W_2) and the net weight of the total suspended solids was calculated according to the following formula: $[(W_2 – W_1) / 25] \times 10^6$.

HACH DR/5000 Portable Spectrophotometer is the instrument was used for the measurement of ammonia, nitrate, nitrite, phosphate, iron, sulphate and total chlorine. To determine the level of ammonia in the studied water samples, 0.1 ml of the target water brand was gently transferred in a clean and dry test tube and two reagents, namely ammonia salicylate and ammonia cyanurate were added. A blank sample was prepared by mixing 0.1 ml of distilled water with the above mentioned reagents under similar conditions. To estimate the value of nitrates in water, 1 ml of each sample was injected in nitrate reagent test tube and the instrument was zeroed on the sample itself before reagent addition. Nitrate reagent was added, then the sample was put in the instrument and the readings were taken after five minutes. An amount of 25 ml of the waster sample was placed in a glass cell and the same amount of distilled water was put in another cell to be the blank. 1 ml of two reagents, namely Molybdate and Amino acid were added to each cell.

RESULTS

Data concerning the physicochemical and bacteriological properties of the studied water types are recorded in Tables 1, 2 and 3, respectively. Figures 1, 2 and 3 show the levels of total dissolved solids (TDS), turbidity and nitrates in ablution water, respectively. It could be noticed from Tables 1, 2 and 3 that the pH values are located on the weak alkaline scale. Except for a moderate alkaline (pH = 8.36) water sample collected from the washing basin of a restaurant, all the studied water samples attained pH values ranging between 7.31 and 7.82.

The total dissolved solids in the studied water samples varied markedly among studied water samples (Figure 1). The maximum TDS gradient was recorded for ablution water (4490 mg/L), while the minimum value was recorded for the household water (46 mg/L). Data recorded in Tables 1, 2 and 3 indicate that 5 ablution water samples, 2 restaurant water samples and only one household water sample attained TDS levels over 2000 mg/L. Other studied water samples were freshwater; their TDS levels ranged between 460 and 570 mg/L.

The vast majority of the studied water samples showed relatively high levels of sulphate salts. The sulphate content varied between 33 and more than 150 mg/L. Ablution, restaurant and household water samples were either slightly chlorinated or non-chlorinated (Tables 1, 2 and 3). They were either clear or murky, indicating variable degrees of turbidity/transparency among studied water samples. The maximum turbidity value was recorded for ablution water (7.30NTU colour units), while the minimum level was documented for household water (0.49 NTU colour units) (Figure 2).Nitrates showed marked variability among studied water samples (Figure 3). The maximum nitrate level was recorded for ablution water (12.2 mg/L), while the minimum value was documented for the same water type (0.6 mg/L). Data obtained revealed that nitrite levels of the studied water samples were safe; the maximum and minimum values were 0.002 and 0.17 mg/L. Out of 19 examined water samples, 6 ablution water and 3 household water samples were contaminated with bacteria (Figure 4).However, water used in restaurants was free of bacteria.

DISCUSSION

In recent years, the water sector put great pressure on the economy of the Kingdom of Saudi Arabia. Water rights are the framework for allocating water resources to water users. According to the report issued by UNICEF (2010), about 85% of the global population had house connections to municipal system or to an amended water source such as protected wells. However, about 14% did not have access to potable water sources to meet their water demands. It is worth noting that the static, more lentic groundwater in aquifers is replenished at a slow rate due to the scarcity of the charging surface water reserves. The residence time of water in deep, confined groundwater aquifers may exceed 20000 years.

Continuity of the current water consumption regimes is expected to widen the scarcity map of the World. Water overconsumption requires increased water mining projects and associated energy costs.

TDS in water supplies originate from natural sources, sewage, urban and agricultural run-off, and industrial wastewater. Concentrations of TDS from natural sources vary from less than 30 mg/L to as much as 6000 mg/L. Certain components of TDS, such as chlorides, sulfates, magnesium, calcium, and carbonates, affect corrosion or encrustation in water-distribution systems. High TDS levels (>500 mg/L) could induce massive scaling in water pipes, water storage tanks, water heaters, boilers, and household appliances such as kettles and steam irons. As a result, he service life of these appliances become shorter. In the light of the present findings that revealed high TDS levels in about 40% of the studied water samples. Moreover, high salinity levels in ablution water can affect the human health. Ablution, household and washing water exhibited relatively high levels of sulphate and this may pose potential hazard to human health. An amount of 8 g of sodium sulfate and 7 g of magnesium sulfate led to catharsis in adult males (Morris and Levy, 1983). Catharsis refers to any extreme change in emotion leading to renewal and restoration (Heron, 1998).

Close inspection of the mosques over ten years indicate that water is used for ablution, hair washing and sometimes showering. The taste of this water brand is likely salty and odorous. Hard water attains a high level of minerals. The effects of hard water on hair and skin can be negative. Hard water can verily dry out the hair and make it more difficult to perfectly rinse out the shampoo and conditioner. This makes the hair look dull, the scalp dry and itchy and is difficult to comb or brush out (Amber *et al*., 1999).These tangles and knots make it more difficult to wash, and amounts of soap and shampoo will likely remain stuck onto the hair. This causes flab and film to build up on the hair and on the scalp (Rubenowitz-Lundin and Hiscock, 2013). In addition, the hard water is very rugged on the hair. Some people find that the effects of hard water make their hair to become thinner in appearance or more prone to breakage. Furthermore, hard water combined with frequent hair treatments commonly leads to dandruff and an itchy scalp. The problem is exacerbated as this buildup continues to increase. Dry skin is one of the most common problems of prolonged exposure of

e-ISSN: 2395-0463
Volume 01 Issue 04
May 2015

hard water. As hard water makes it more difficult to rinse soaps and shampoos from the skin, the skin may also become irritated. The well water contains many minerals, particularly calcium and magnesium. Such hard water is a common problem for many households. When the water comes in contact with the skin, a small portion of the minerals are left behind. These deposits can leach the moisture and natural oils from the skin. Sensitive skin likely has problems when being exposed to the hard water. Psoriasis and eczema patients often experience marked dryness and irritation following exposure to hard water (McNally *et al*., 1998; Miyake *et al*., 2004; Arnedo-Pena *et al*., 2007). People should limit their exposure to hard water. Taking shorter showers and using bottled or filtered water to wash the face are recommended. As hard water can prevent soaps and shampoos from lathering properly, many people tend to use more than is necessary. These excess products will usually only lead to more of a buildup on the skin. To prevent the soap from creating a residue and clogged pores, individuals with hard water should use only the normal recommended amount, or less, if possible.

There are a few ways to palliate the effects of hard water on hair. Some people add water softeners to their home water systems in order to reduce the minerals in the tap water throughout the whole home. Some find that using clarifying shampoo once or twice a week helps to remove buildup, though for people with an especially dry scalp, this might not be a good idea. It generally takes some trial and error using different types of shampoos and conditioners to find the combination that works best with hard water; there are some shampoo products available that are specifically designed for use in hard water. To prevent hard water from affecting skin, people can limit their exposure to hard water and use less soap on their bodies.

Nitrate joins surface and groundwater as a consequence of agricultural activity, from wastewater treatment and from oxidation of nitrogenous waste products, including septic tanks. Nitrite can also be formed chemically in water pipes by a kind of bacteria known as Nitrosomonas (WHO, 2011). Under aerobic conditions, nitrate can percolate in relatively large quantities into the aquifer when there is no growing plant material to take up the nitrate and when the net movement of soil water is downward to the aquifer (WHO, 2011). Degradation or denitrification occurs only to a small extent in the soil and in the rocks forming the aquifer. Under anaerobic conditions, nitrate may be denitrified or degraded almost completely to nitrogen. The presence of high or low water tables, the amount of rainwater, the presence of other organic material and other physicochemical properties are also important in determining the fate of nitrate in soil (Dubrovsky and Hamilton, 2010). Nitrification and denitrification may occur in surface water and is affected by temperature and pH.

Turbidity is the amount of cloudiness in the water. Turbidity reflects suspended solids and particulate matter in the waterbody. Factors causing turbidity include silt, sand and mud; microorganisms and chemical compounds. High turbidity fills water storage tanks and pipes with mud and silt, and can lead to corrosion of the valves and taps. The higher the turbidity level in drinking water, the higher the risk that one may develop gastrointestinal diseases (Mann *et al*., 2007). As contaminants such as bacteria or viruses can attach to the suspended solids in water, suspended solids could interfere with water disinfection with chlorine. This is especially problematic for immunocompromised patients. Similarly, suspended solids can protect bacteria from ultraviolet (UV) sterilization of water.

Although the ablution and washing water is not ingested into the interior of the human body, it seems likely capable of rendering health concerns, particularly when the water comes in close contact with the skin for a proper duration. Acute myocardial infarction was increased in a community with high levels of soluble solids, calcium, magnesium, sulfate, chloride, fluoride, alkalinity, total hardness, and pH when compared with one in which levels were lower. The water sector authorities of AlQurayyat must take the responsibility of organizing, planning, monitoring, developing, operating and maintaining water mining, water treatment and distribution projects and programs to provide high quality water and suitable service provision.

REFERENCES

[1] Al-Mughalles, M. H.; Abdul Rahman, R.; Suja, F. B.; Mahmud, M. and Abdullah, S. M. (2012). Mosque Grey water Quality in Sana'a, Yemen. The Electronic Journal of Geotechnical Engineering: EJGE, 911-921.

[2] Al-Saud, M.; Teutsch, G.; Schüth, C. and Rausch, R. (2011). Challenges for an Integrated Groundwater Management in the Kingdom of Saudi Arabia. International Journal of Water Resources and Arid Environments 1(1): 65-70.

Al-Zahrani and H. Khodran (2009). Changing Water Consumption Patterns and Behaviors as mean of Water Demand Management in the Kingdom of Saudi Arabia. Proceedings of the Global Conference on Global warming. Istanbul, Turkey, pp (308-319).

[3] Al-Zahrani and H. Khodran (2010). Water Demand Management in the Kingdom of Saudi Arabia Conference of the International Journal of Arts and Sciences 2(3): 68 - 76.

[4] Amber, W.; Kathleen, P. and Blake, R.(June 1999). "Household Water Quality – Water Hardness". Retrieved 2009-04-26.

[5] Arnedo-Pena, A.; Bellido-Blasco, J.; Puig-Barbera, J.; Artero-Civera, A.; Campos-Cruañes, J. B.; Pac-Sa, M. R.; Villamarín-Vázquez, J. L/ and Felis-Dauder C (2007). "Domestic water hardness and prevalence of atopic eczema in Castellon (Spain) school children". Salud Pública De México 492 (4): 295–301.

[6] Dubrovsky N, and Hamilton, P. (2010). Nutrients in the nation's streams and groundwater: national findings and implications. Reston, VA, United States Geological Survey (Fact Sheet 2010-3078;http://pubs.usgs.gov/fs/2010/3078/).

[7] El-Naggar, Ahmed M. (2015). Water Quality of public water coolers in AlQurayyat, Al-Jouf Region, KSA: current status and future aspirations (in print).

[8] Gleeson, Tom; Wada, Yoshihide; Bierkens, Marc F. P.; van Beek, Ludovicus P. H. (2013). "Water balance of global aquifers revealed by groundwater footprint". Nature (488): 197–200.

[9] Heron, J. (1998). Catharsisin Human Development. Co-Counselling International (UK).

[10] Mann, A.G.; Tam, C.C.; Higgins, C.D. and Lodrigues. L.C. (2007). The association between drinking water turbidity and gastrointestinal illness: a systematic review. BMC Public Health. 7(256): 1 - 7

[11] McNally, N. J.; Williams, H. C.; Phillips, D. R.; Smallman-Raynor, M.; Lewis, S.; Venn, A. and Britton, J. (1998). "Atopic eczema and domestic water hardness". The Lancet 352 (9127): 527–531.

[12] Miyake, Y.; Yokoyama, T.; Yura, A.; Iki, M. and Shimizu, T. (2004). "Ecological association of water hardness with prevalence of childhood atopic dermatitis in a Japanese urban area". Environ Res. 94 (1): 33–37.

[13] Morris, B. L.; Lawrence, A. R. L.; Chilton, P. J. C.; Adams, B.; Calow, R. C. and Klinck, B. A. (2003). Groundwater and its Susceptibility to Degradation: A Global Assessment of the Problem and Options for

Management. Early Warning and Assessment Report Series, RS. 03-3. United Nations Environment Program, Nairobi, Kenya.

[14] Morris, M. E. and Levy, G. (1983). Absorption of sulfate from orally administered magnesium sulfate in man. Journal of Toxicology, Clinical Toxicology, 20:107–114.

[15] Rubenowitz-Lundin, E. and Hiscock, K. M. (2013). Water Hardness and Health Effects. In: Selinus Olle ed., Essentials of Medical Geology, pp 337-350.

[16] UNICEF, WHO/UNICEF (2010). Progress on Sanitation and Drinking-water: Joint Monitoring Programme for Water Supply and Sanitation.

[17] World Bank. (2000). World Development Indicators 2000.Washington, DC, USA: The World Bank.

[18] World Health Organization (2011). Nitrate and Nitrite in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality

Table (1). Physicochemical parameters of the ablution water in 9 mosques located in different districts of AlQurayyat.

Location	pH	TDS	Sulphate	Nitrate	Nitrite	Phosphate	Chloride	Turbidity
A	7.31	4490	145	10.5	0.087	8.06	0.07	6.15
B	7.26	3540	130	7.9	0.065	2.35	0.05	4.21
C	7.42	570	89	2.5	0.017	1.64	0.08	0.76
D	7.82	2280	100	5.8	0.048	1.68	0.08	2.30
E	7.31	484	87	0.6	0.002	1.54	0.00	0.61
F	7.31	492	87	4.2	0.019	6.26	0.11	0.57
G	7.30	497	85	0.7	0.015	1.54	0.00	0.71
H	7.45	2750	> 150	12	0.022	1.34	0.00	2.11
I	7.58	3720	> 150	12.2	0.040	2.08	0.03	1.80

Table (2). Physicochemical parameters of the washing water in 3restaurants.

Location	pH	TDS	Sulphate	Nitrate	Nitrite	Phosphate	Chloride	Turbidity
A	8.36	3360	> 150	7.2	0.028	2.25	0.15	7.30
B	7.61	520	87	1.1	0.008	1.36	0.11	0.87
C	7.52	2260	127	4.7	0.015	1.97	0.09	3.41

Table (3). Physicochemical parameters of household water in 7 houses.

Location	pH	TDS	Sulphate	Nitrate	Nitrite	Phosphate	Chloride	Turbidity
A	7.31	520	82	3.7	0.020	1.52	0.12	0.74
B	7.26	2130	147	11.8	0.170	5.33	0.31	5.51
C	7.23	460	85	2.4	0.017	1.64	0.08	0.62
D	7.32	1831	123	10.5	0.110	3.96	0.10	1.94
E	7.26	370	33	2.7	0.018	2.28	0.24	0.51
F	7.32	475	87	3.0	0.016	2.66	0.12	0.49
G	7.30	476	88	3.8	0.021	3.18	0.12	0.53

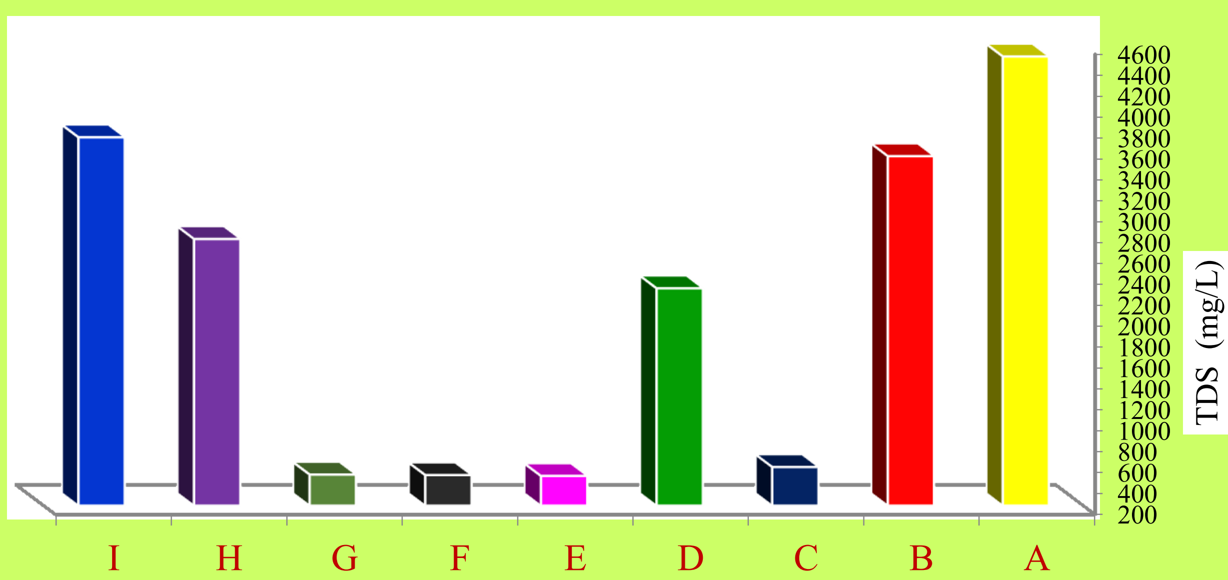

Figure 1. Total Dissolved Solids TDS of water in 9 mosques of AlQurayyat.

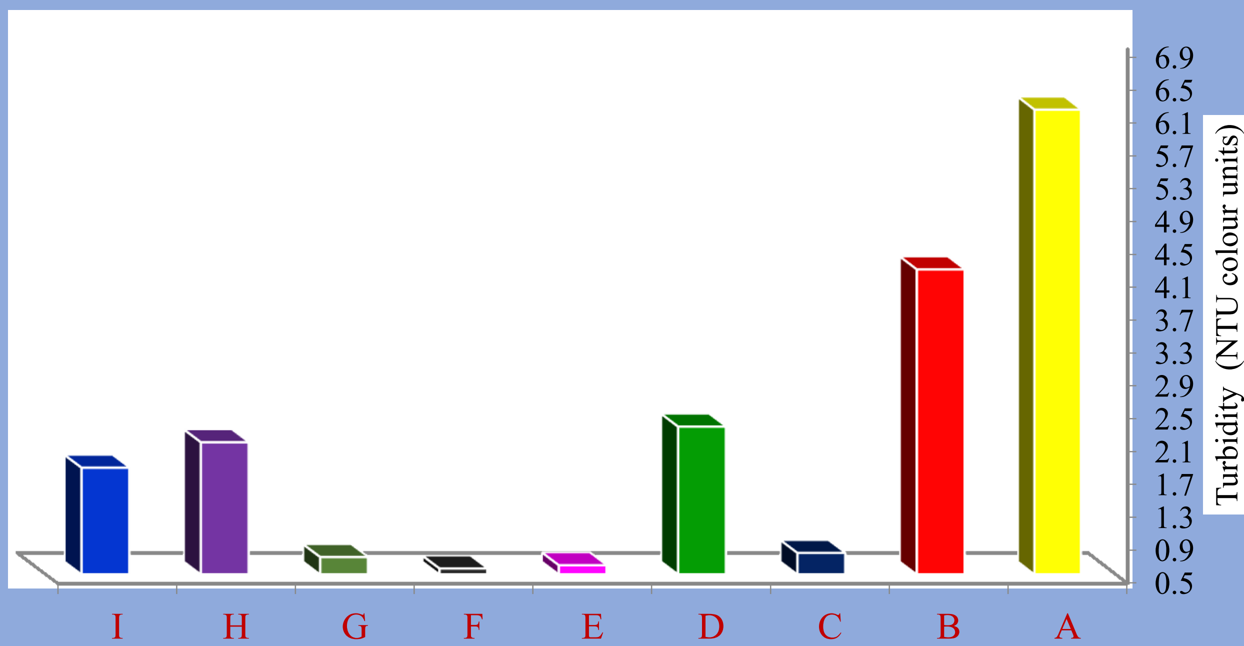

Figure 2. Turbidity levels of water in 9 mosques of AlQurayyat.

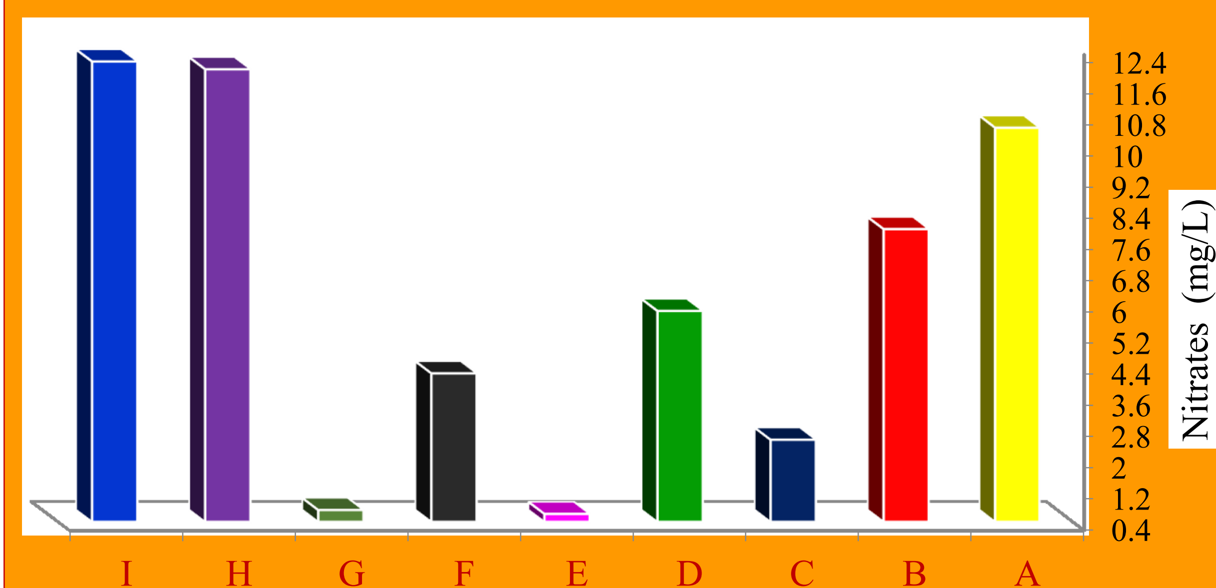

Figure 3. Nitrate levels of water in 9 mosques of AlQurayyat.

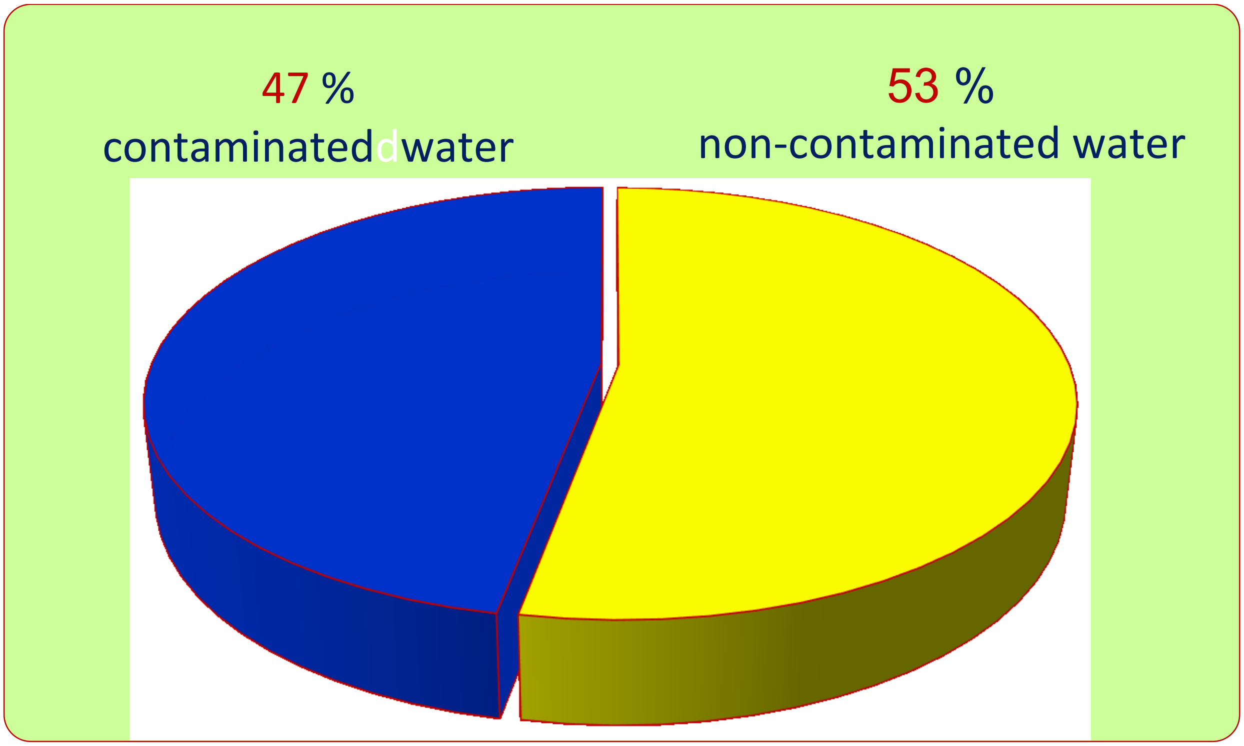

Figure (4). Percentage of water contaminated with bacteria (47%) to water free of bacteria (53%) and being used for ablution, household and washing purposes.