Physical, Chemical and Bacteriological contamination of Drinking Water Sources of Taluka Sehwan, District Jamshoro, Sindh

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Abstract:

Background:

Water pollution is one of the major threats to public health in Pakistan. Worldwide, around one billion people lack access to safe water supply, and two million annual deaths are attributed to unsafe water, sanitation and hygiene. Drinking water quality is poorly managed and monitored. Drinking water sources, both surface and groundwater are contaminated with coliforms, toxic metals and pesticides throughout the country. The drinking water quality parameters set by the WHO are frequently violated.

Objective: The objective of this study was to determine the concentrations of various pollutants in drinking water in Taluka Sehwan, Sindh; and disseminate information for the control of community health hazards

Material and Methods: The drinking water samples were collected from 36 randomly selected water sources from the villages of four union councils of Taluka Sehwan as per standard procedure. These samples were transported to Water Testing & Surveillance Laboratory, Department of Community Medicine, Liaquat University of Medical & Health Sciences, Jamshoro, Sindh and were assessed for physico-chemical parameters like turbidity, pH, EC (Electro Conductivity), salinity, TDS (Total Dissolved Salts), arsenic and chlorides. The water samples were also analyzed for the presence of fecal bacteria.

Results: The turbidity of 28 out of 36samples was within permissible limits of NSDWQ/WHO. The EC of only three samples was within the permissible limits; and TDS of 32 samples was above the permissible limits. All pH values were in standard range i.e. 6.5 to 8.5. Arsenic was found higher than permissible limits in six samples; and Chlorides were within the Pak/ WHO criteria of only four samples. Eight samples contained unacceptable number of coliform.

Conclusion: Drinking water of the surveyed areas was found contaminated with arsenic, chlorides, TDS, and with coliform bacteria due to improper disposal of sewage and excessive application of fertilizers. The quality of drinking water was below the required standards, hence unfit for human consumption.

Keywords: Water Contamination, Drinking Water, Unsafe Water, Health Impacts

Introduction:

In developing countries like Pakistan, the water contamination ratio is much higher due to disarrangement, natural disaster and bad civic conditions. Clean drinking water is not properly supplied in urban areas of Pakistan..[1]In most remote areas of the developing countries, drinking water contaminated with pathogenic microbes of fecal origin is a significant risk to human health.[2]Around 250 million cases of water born diseases are reportedworldwide[3]; and annually25 million death are attributed to water born diseases.[4]In developing countries,40% children under 5 affected by diarrhea; and due to prevalence of diarrhea, among 1.5 billion cases, 4 million ends with death.[5]According to WHO, 80% cases of all sickness and diseases in developing countries are due to water-borne pathogens. In developed countries,95% of the population has access to safe and clean drinking water. In developing countries the situation is quite different, where 2.5 billion people have no access to proper sanitation system and more than half of the above said population has no supply of safe and clean water.[4]In Pakistan, the urbanization process is also a serious threat to drinking water quality. The availability of safe drinking water is reduced due to exponential growth in urbanization.[6]In Pakistan, around 60% deaths occur due to use of contaminated water.[7]

In the last two decades, water borne diseases have registered an increase of 200%.[8]The cases of gastro-intestinal and kidney disease are on the rise in

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Sindh.[9]Around 40% of deaths are related to water-borne diseases; and about 25-30% of all the hospital admissions are connected to water-borne bacteria and parasitic conditions; and 60% infant deaths are associated with the same infections. Most common routes for the spread of diseases with symptoms like eye infections, irritation of skin, fever, loss of appetite, numbness in hands, abdominal painand hair loss are by drinking of water and bathing. Throughout Sindh cases of cancer have also increased. From diminished river flows in Sindh, these health problems are attributed to water pollution.[10]In those areas of Sindh where water scarcity is the most severe, some unusualhealth problems have also been reported. These include mental illness in the Indus delta area, eye and skin diseases in the Kohistan area of Sindh.[11] In many parts of Sindh, the drinking water supplies have diminished and degraded in quality due to water shortage and depressed quality of the surface water bodies and loss of groundwater due to salt-water intrusion and water table depression. There has been increased incidence of diseases related to drinking polluted water. Because of poor and inadequate health sector spending by the government, the worsening situation is bound to create havoc in terms of public health and safety.[13]

The main objective of the present work was to assess the contamination of drinking water and disseminate information for safe water supply. Materials Methods: Water samples were collected from thirty six sources of four union councils (11from U.C Sehwan, 12 from U.C Bubak, 08 from U.C Channa and 05 from U.C Dall of Taluka Sehwan during the period of three months from January 2013 to March, 2013. At each source, the water was allowed to flow for 3-5 minutes, and then samples were collected in 0.5 polystyrene bottles, which were rinsed three times before the collection of water samples. The EC (Electro Conductivity), Salinity, TDS (Total Dissolved Salts) and Temperature were analyzed by conductivity meter (Model no: Sanso direct con 200) on the spot of sampling stations. For Bacteriological analysis, the samples were collected in sterilized bottles and kept in ice box for further processes. These samples were transported to the Water Testing & Surveillance Laboratory, Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro. The WHO and Environment Ministry of Pakistan' standards for water quality (table 1) were used for the comparison of collected water samples.

Physicochemical Analysis: EC, Salinity, TDS were analyzed by conductivity meter and pH was measured by pH meter (Multipara water quality meter, Bante Instruments USA), Turbidity was measured on turbidity meter (model PCheckit Germany), and Arsenic was measured with Merk Arsenic Kit. [12]

Bacteriological Analysis: Bacteriological analysis of drinking water samples were done by Multi-tube Fermentation Method[13]. The Most Probable Number (MPN) of bacteria present in water sample was estimated from the specially developed statistical table. Confirmatory test on selective culture medium were also performed.

Coli form: Coli form bacteria analysis of drinking water samples was done by MPN method of diluted samples 1:10. Lauryl Tryptose Broth and Brilliant Bile Broth were used as a growth media.

Fecal coli form: Fecal coli form bacteria were analyzed by inoculation method. Coli form positive Lauryl Tryptose Broth tubes were inoculated on EC Broth and incubated for 24 h at 44.5°C.

E. coli: E. coli were analyzed by streaking method. Streak inoculums loop from positive EC Broth tube on Eosin Methylene Blue Agar plates and incubated for 24 to 48 hours at 35°C. E. coli colonies were confirmed by indole test.

Results:

Among all the 36 water samples collected from four union council of Taluka Sehwan District Jamshoro, 24 water samples were of ground water, 5 were of Manchur lake, 5 from water supply plant of Sehwan, one of river (sapna lake), and one of sapna lake (Inlet water supply line). All the results of physical, chemical and microbiological parameters of collected water samples are shown in table 2.

Turbidity: Turbidity of 28 samples was within the permissible limits of NSDWQ/WHO, and eight water samples (numbers 1, 2, 3, 4, 7, 10 of UC Sehwan and 12, 15 of UC Bubak) had much higher (table 2) than the permissible limits of Pakistan NSDWQ/WHO.

Electro Conductivity: Only sample no: 13, 14, and 18 were within the permissible limits, otherwise remaining all the samples were higher than permissible limits.

Salinity: All the samples were higher than permissible limits, except sample number 18. The sample no: 13 and 14 were slightly lower than permissible limits.

Total Dissolved Salts: Only four samples (no: 11, 13, 14 and 18) were within permissible limits; and the vast majority of 32 samples were found with TDS above the permissible Pakistan NSDWQ/WHO criteria.

pH: All pH values were in standard range, except two (sample no: 13 and 14), which were slightly acidic in nature

Arsenic: Thirty samples were within permissible limits, according to table 1; and six samples (no: 20, 21, 24, 25, 28, 31) had higher concentration of arsenic than permissible limits (table 2).

Chlorides:

In our study, 32 samples were found with higher than permissible limits; only four samples (no: 11,
13, 14 and 18) were within the Pak/ WHO criteria.

Bacteriological Analysis: Result showed that eight water samples (from sample no: 1 to 8, table 2) contained unacceptable number of coliform. All other samples were free from the bacteria.

Discussion:

Drinking water choices represent not only the history and development of a society, an economy and a culture, but also knowledge and concept of public health and drink-

ing water hygiene.[15] Surface and groundwater sources being contaminated with different pollutants, and consumed by human beings, are responsible for numerous human health hazards.[16]

It is a general belief that groundwater is safe and free from contamination, and no treatment is required before its use. But many factors distort the quality of groundwater and cause health problems. Some indirect health effects have also been attributed to poor quality drinking water.[17]The water quality parameters, their permissible limits and their health effects are shown in table 3.

Turbidity: It is the presence of fine suspended particles in water.[18]Turbidity can provide shelter for opportunistic microorganisms and pathogens. In district Matiari, Sindh, turbidity higher than standard values was reported in 5.8% of the study samples[19], whereas in our study, it was found in 22.2% of the samples.

Electrical Conductivity (EC): This is a measure of water capacity to convey electric current. It denotes the amount of total dissolved salts (TDS).[20] High EC values indicate the presence of high amount of dissolved inorganic substances in ionized form. This was observed in higher than standard values in 91.66% of the samples. In a previous study, which was conducted in Kohat, Pakistan, the results showed 63.15% high values of EC than the permissible range. The increased values of conductivity may be due to high concentrations of sodium ions, chloride ions along with other dissolved ions present in the water.[21]

Salinity values in our study ranged from 0.1 % to 5.3%. This only affects the water taste.

Total Dissolved Salts (TDS): These indicate the salinity behavior of ground water.[20] High TDS show elevated levels of ions (like Cu. As, Al, NO3 and others) that do pose a health concern. In our study 88.88% values were higher than permissible limits. In another study conducted in Kohat, 75% samples showed high values than permissible limits of Pak/WHO.[21]

pH: A vast majority of water samples were alkaline in nature. Two samples (13 and 14) were slightly acidic in nature. The pH beyond normal range can affect mucous membrane of cells and cause corrosiveness in water supply. This may also result in gastrointestinal irritation.[16]

Arsenic: The Arsenic value ranged from 0.005 mg/L or (50µg/L) to 0.1mg/L or (10µg/L) in our study. Arsenic contamination is a serious problem. In many previous studies it has been found as: Kasur 100%, Multan 94%, Bahawalpur 88%, Gujranwala 64%, Sheikhupura 73% and Lahore 100%.[20] In Matiari district 25.88% Arsenic contamination was reported.[19]

In our study, Arsenic contamination was found 16.66% and 66.66% higher than permissible levels of Pakistan NSDWQ and the WHO respectively. The use of phosphate fertilizers has been suggested to elevate the arsenic concentrations in groundwater.[16]

Chloride (Cl):

Chloride is a commonly present in all types of rocks in many forms. Natural sources, industrial effluents and sewage are the main causes of chloride in drinking water.[20] The taste of water is altered with the excess of chloride (about 250mg/l).[21]

Other studies have also reported high concentration of chlorides in water. High chloride concentration results in the high conductivity which is considered to be a risk for human health.[18]

Bacteriological Analysis:

Eight water samples (no: 1to 8) contained unacceptable number of coliform hence unfit for human consumption. Coliform bacteria may not cause disease, but used as one of the indicators of pathogenic contamination. This may be due to seepage / discharge from septic tanks, lack of sewage and solid waste disposal systems. In a previous survey conducted in Khairpur district, Sindh, fecal coliform bacteria were reported in all 100% of the samples; and in Muzafarabad city 18% samples were contaminated with E.coli.[22]These are the major threats to water resources that can cause diseases such as intestinal infections, dysentery, hepatitis, typhoid fever, cholera and other illnesses.[16]

Conclusion:

The drinking water of selected areas was contaminated with Arsenic, chlorides, total dissolved salts, in addition to contamination with coliform bacteria.Improper disposal of solid waste, sewage, sludge and excessive application of fertilizers and pesticides have contaminated the drinking water. This drinking water is not fit for human consumption. The efforts should be taken to tackle this issue seriously, and awareness about safe drinking water should be given to public through variety of media.

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