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Physico-chemical and microbial analysis of drinking water contaminated with industrial waste in Hattar District, Khyber Pakhtunkhwa, Pakistan

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Abstract

Water is one of the most essential needs for the continued existence of all living organisms on earth. In Pakistan, there is a problem of safe drinking water which is caused by heavy metals due to the presence of chemical industries located in Hattar, District KhyberPakhtoonkhwa, Pakistan. Total Twenty seven (27) water samples were collected from Dingi, Motiyan located near the industrial state of Hattar, KhyberPakhtoonkhwa. Water samples were analyzed in laboratory of Microbiology, Comsat University Abbottabad from January 2015- March 2015. All of the water samples analyzed were not free from the load of Total plate count and coliforms, the highest load of coliforms detected was less than >300 and Aerobic plate count (APC) was 250, while the lowest count detected was 30 and 6 while highest load of lead, cadmium, nickel and chromium detected was (2.808, 0.040, 100, 0.940) mg/L and the lowest count was (-0.006, -0.002, 0.001, -0.133) mg/L in different water samples. With three (3) month research it was concluded that all of the water samples were not fit for drinking because of presence of high load of coliforms and various types of heavy metals. It is considered and suggested guideline for Water Safety Plan for schoolchildren and teachers, which aims to train the children and teachers on simple methods for determining the water quality themselves.

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Introduction

Water plays an important role for the survival of human beings, and all of the living organisms need water in order to fulfill the daily life requirements. Water is used mainly by various types of individuals for their basic needs, these individuals includes microorganisms, plants and animals and the mostly by the human beings. Uptill now no single microorganism have been discovered that can live without water (Sofola *etal.,* 1983).

In life of human beings water plays an important role. According to the report of world health organization maximum thirty six percent of the urban and sixty five percent of the rural have no access to safe drinking water (Saadullah*etal.,* 2014). In homes water is used for drinking purpose, but that water is not free from contamination of different type disease causing microorganisms and of large amount of heavy metals and chemicals is also present(WHO, 2009).For proper growth and nourishment all of the living organism need specific nutrients and compounds among these specific compounds water is the most important amongst them (Kondal, 2011; Tortora, 2002).

It has been reported that water plays an important role in transmission of various types of waterborne diseases which includes cholera, diarrhea, typhoid fever and dysentery and these disease mainly occur by consumption of untreated water (Yau, 2003).

Throughout the globe majority of the people depend upon non-public water supply system, due to lack of land or due to heavy construction in the streets, these water supply pipes are passed nearby the waste sewage pipes which can contaminate the water, and act as a source of transferring various types of diseases (Okonko, 2008). In developing countries the increase rate of human population put huge pressure on the provision of safe drinking water. In nature water is present in impure form and this impurity comes from the rainfall, during combustion of fossils fuels origination of sulfur compounds are mainly responsible for acid rain (Abraham, 2010). After raining water which seeps down in earth are free from various types of water borne pathogens and also having the minute amount of heavy metals, that why the water sources of springs and deep wells are mainly of good quality and suitable for consumption (Saleem and kamili 2011). Contamination of water occur when such types of pathogenic microorganism i:e *E.coli*, *Salmonella*, *Shigella* can enter (Bharti and Katyal, 2011). The main aim of the research study was to investigate the coliform and heavy metals present in the drinking water of Houses present in Dingi and motiyan village.

Methodology

Household sampling

Household living adjacent to the waste water channel was marked through GPS equipment for coordinates which was transformed in to the Google earth for buffer zoning. Arc GiS was used to map the sampling points. Random sampling for the household will be made with in the area of 500 meters adjacent to the waste water channel (Ghazi*et al.,* 2014).

Water sampling

Water sampling was done from the household's drinking water sources marked through GIS. Household's water sampling was made from the drinking water sources at home.

Water tests

Household's drinking water put for microbiological lab analysis and for instrumental lab analysis. In microbiological lab water was analyzed for coliforms, Total bacterial count and in instrumental lab water was tested for heavy metals like Lead, cadmium, nickel and chromium on atomic absorption plant.

Preparation in standard

I have stock solution of 1000 ppm for all the elements and the standards were prepared by formula, $C_1V_1 = C_2V_2$. Where,

C_1 = 1000 ppm

V_1 = The volume which is obtained from 1000 ppm stock solution.

C_2 = Desired ppm which I prepared.

V_2 = (50 ml) volume of the flask in which standards will prepared

All the standard were prepared by putting the values in this formula.

Metals analysis

First I calibrated the Atomic Absorption Spectrophotometer by running the 5-standards for each metal. I prepared 1, 5, 10, 15, 20 ppm standards for (Pb) lead, standards for Cd 1,2,4,6 ppm, standards for Cr 1, 5, 10, 15 ppm, standards for (Ni) Nickel 1,2,4,6 ppm. On Atomic Absorption Spectrophotometer first the element was selected then the standards of these element were analyzed on the Atomic Absorption Spectrophotometer, The Atomic Absorption Spectrophotometer display straight line with Characteristic Coefficient = 0998. After standard analyzing I analysis the water samples for that element the data obtained in printed form.

Statistical analysis

All of the data was analyzed in three replicates and was mean was taken out by using Microsoft excel 365, and all of the graph was prepared in Graph pad prism portable version.

Results

Microbiological investigation of Coliforms

Out of total twenty seven water sample that was collected from the two major areas of Hattar district in fifteen (15) water samples total coliforms and total bacteria load were present. Highest load of Total Plate count that detected was 250 followed by 160, 140, and 120 while the lowest total Plate count reported was 6. All of the water samples were free from feacal coliforms (Fig. 1 and 2).

Physico-chemical analysis

The Physico-chemical analysis was done in the instrumental laboratory, As in accordance with the European Union, EPA (USA) and EPA Pakistan, the guideline value of Heavy metal in water is recommended as 0.05 mg/liter. But as in our study case in all of the water samples collected from the industrial zone of Hattar district showed the presence of various types of heavy metals which mainly includes Lead, cadmium, nickel and chromium. The highest load of lead, cadmium, nickel and chromium detected was (2.808, 0.040, 100, 0.940) mg/L and the lowest count was (-0.006, -0.002, 0.001, -0.133) mg/L in different water samples.With three (3) month research it was reported that all of the water samples were not fit for drinking because of presence of high load of heavy metals. The presence of heavy metals in drinking water effects the mental growth inchildren and causing kidney diseases in Adults and such concentration of heavy metals showed severe effects in the community drinking the contaminated water.

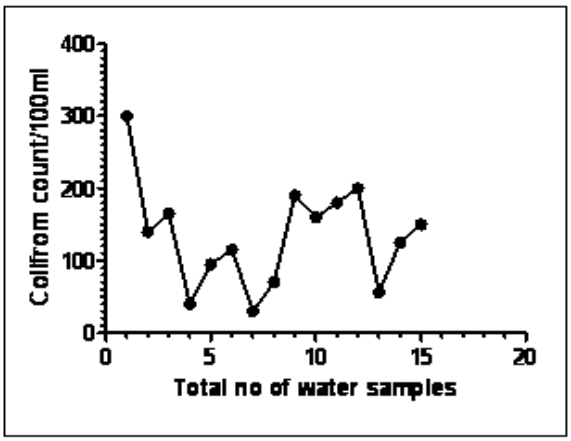

Fig. 1. Presence of total coliforms in water samples /100ml.

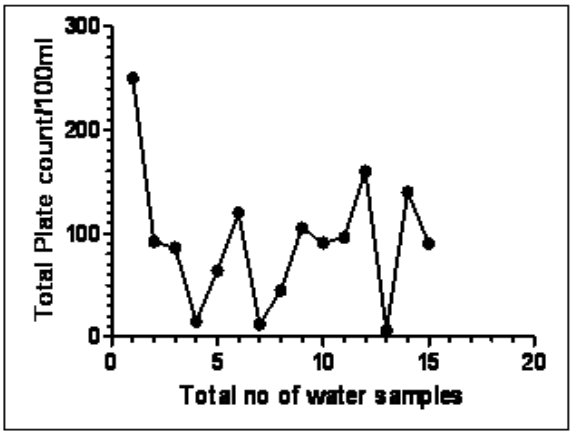

Fig. 2. Presence of Aerobic plate count in water samples /100ml.

Discussion

Water plays an essential role in human life. According to WHO reports that approximately 36% of urban and 65% of rural Indian's were without access to safe drinking water. Normally water is mainly used for domestic purposes especially for drinking. All living organisms require a wide variety of inorganic compounds for growth, repair, maintenance and reproduction. Water is one of the most important, as well as one of the most abundant of those compounds and it is particularly, vital to living organisms. In many developing countries, availability of water has become a critical and urgent problem and it is a matter of great concern to families and communities depending on non-public water supply system. Increase in human population exerts an enormous pressure on the provision of safe drinking water especially in developing countries. A total of twenty seven water samples was collected from the two main areas of Hattar which are present near the industrial line, total twenty seven water sample that was collected from the two major areas of Hattar district, out of twenty seven fifteen samples were contaminated with the load of coliforms, and its ranges varies from >300 to 30 which is unacceptable for consumption, our study results are similar with the result of (Griffith *et al.,* 2003) he concluded that total coliforms were apparently present but it is important to note that coliform bacteria are widely distributed in nature do not necessarily specify fecal pollution. In this study lead, cadmium, nickel and chromium were also analyzed respectively in all the sources of drinking water, the ranges of lead (2.808 mg/L),cadmium (0.040 mg/L), nickel (100 mg/L) and chromium (0.940 mg/L) our finding are some in comparison with the study of (Ayers and Westcott, 1985) reported different highest values of all the metals in drinking water.

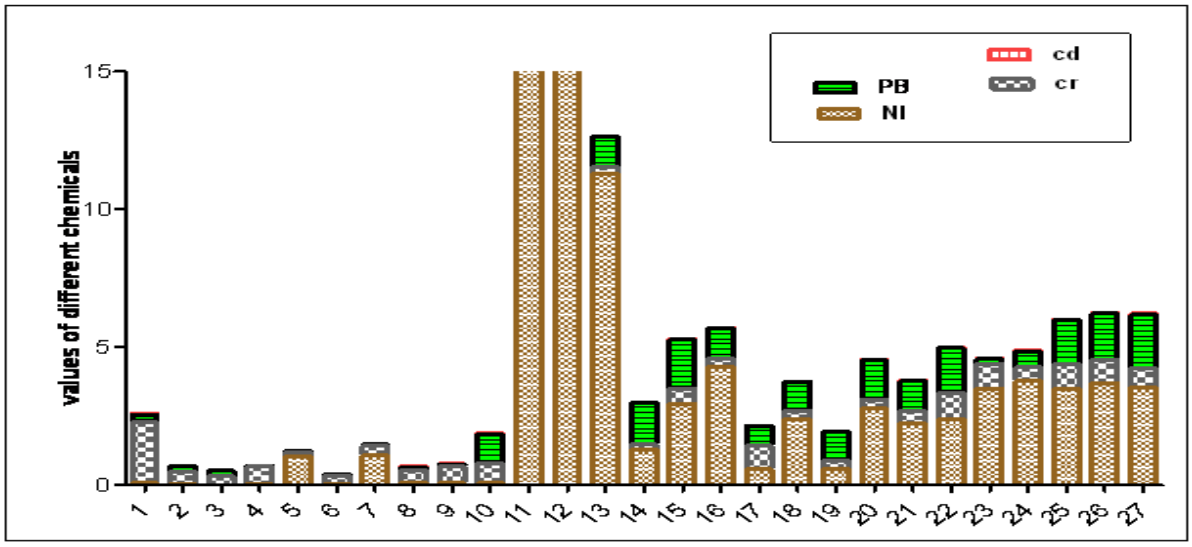

Fig. 3. Showing various values of different heavy metals presence in industrial polluted area of Hattar district.

Conclusion and Recommendations

Population of research area is at risk because of the consumption of the water contaminated with the highest load of coliforms and heavy metals, by consumption of such type of water can affect their Economic/Social livelihood, productivity and living standards which thereby can increase the disease cost burden over the poor people. It is caused due to unavailability of sanitary epidemiological service.It is considered and suggested guideline for Water safety plan for school children and teachers, which aims to train the children on simple methods for determining the water quality themselves. It is also recommended to develop publications on simple methods of bio indication of water samples for children of different ages, separately for kindergarten and school ages inorder to rise their knowledge on healthy environment and clean water.

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